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REVIEW OF MINING

INTRODUCTORY. — The past month was rendered conspicuous in the records of mining by the announcement of a wonderful gold discovery in British Columbia; whether confirmed or disproved, the news had an obvious effect in re-awakening an adventurous spirit throughout the mining regions of the world.

In the early part of June the stock market was depressed by a number of special settlements in rubber shares and by forced liquidations at Paris, notably in Rio Tinto shares. Apathy and decline ensued. Everyone of the mining departments suffered: Kaffirs, Rhodesians, and West Africans. And this despite generally favourable news from the mines. Even the lifting of quarantine on the West Coast, marking the end of a yellow fever scare, failed to stimulate dealings. Later, the tone improved in sympathy with the bourses of Paris and Berlin, despite the panicky conditions on Wall Street due to railroad legislation. Thus the month ended in cheerful activity. We expect no marked liveliness until after the summer holidays, by which time the Britisher will be ready for new commitments and the American will have realized his harvest and released the enormous amount of money involved in the transfer of grain from the farms of a continent to the markets of the world. Meanwhile the political outlook is fairly clear: the new Budget is without fresh exactions, the Conference for a possible adjustment of the legislative veto of the House of Lords is having frequent sessions, and domestic affairs are peaceful. Like the weather, the political sky is crossed by frequent clouds, scattering light rains, but giving recurrent promise of sunshine.

The rubber boom has abated its violence, the special settlements having severely taxed the financial resources of speculators. In consequence, the attention of the public has been diverted to mining scrip, including oil shares, in which a healthy interest is manifested. The search for oil and the exploitation of that mineral all over the world is no passing phase of speculation, but, we believe, the beginning of a new industrial activity of far-reaching importance. With the extended use of oil for steam-raising purposes and for direct combustion in gas engines, stimulating the growth of the motor trade, on land, on sea, and in the air, it is certain that an increasing demand for liquid fuel will be created. It is for geologists and promoters to supply this demand.

SOUTH AFRICA.—The annual report of the Transvaal Chamber of Mines for 1909 is now to hand; while the information it contains is a little late, there is much in the volume to arrest attention. Thus we note that the number of stamps at work on the Rand increased from 9035 to 9252 during the year, but this small increase was supplemented by the addition of 148 tube-mills, whereby the average duty was raised from 4·86 tons to 6·85 tons per stamp. Thus the tonnage crushed was as great as would have been within the capacity of 13,161 stamps in 1902. The working cost, which was 18s. 5d. per ton in January 1908, had been reduced to 17s. 2d. in December 1909; during the same period the profit declined from 12s. 7d. to 11s. 2d. per ton.

For the first half of 1910 the Rand gold-mining companies have distributed £4,222,659 in dividends, or £58,890 more than in the corresponding half of 1909. For the first six months of 1906 the amount was only £2,435,084. Interim dividends this year are lacking from the Durban Roodepoort, Glencairn, Rietfontein, and Jupiter, but among those doing better than last year are the Goch, Randfontein South, Langlaagte Estate, and Main Reef West.

The 'square fathom,' as a unit of mine exhaustion, was explained at the recent meeting of the Village Main Reef company, and the explanation, by Mr. H. F. Marriott himself, has served to invite further criticism. It will be noted that our correspondent at Johannesburg expresses a strong prejudice against the innovation, but we deem it well to await results. The scheme is under trial now and the practical operation of the unit will be disclosed at an early date. Meanwhile Mr. Marriott is wise in offering the fullest explanation, for one of the obvious drawbacks to the scheme is that it bewilders the public, which thereupon become suspicious. The feeling exists that 'the big houses' are not unwilling to confuse the public under cover of a technical improvement; that is an idea detrimental to confidence in the Rand as a field for investment, and it is well therefore that the use of the 'square fathom' should be explained frankly and fairly, as we have already done in our issues for April and May.

Attention has been drawn again to the seriousness of the labour problem by the rapid and successive drop in the profits of the Jupiter company, together with the statement that 75 stamps in the Jupiter-Simmer mill are idle on account of the inefficiency of the native labour in the mine. During June it was also announced that the Durban-Roodepoort Deep was unable to pay an interim dividend by reason of a scarcity of labour. Complaints are heard from other quarters, and as the seasonal migration of Kaffirs is due at this time, it may be expected that scarcity, as well as inefficiency, in the labour supply will tend to hamper mining operations on the Rand.

RHODESIA.—The decrease in the Rhodesian gold output from 55,137 oz. in April to 54,319 oz. in May, is not significant, for it is slight, having regard to the fact that 183 mines contribute. But it is noteworthy that the decrease is due to the smaller mines and it is also worthy of remark that the output in the corresponding month of 1909 and 1908 was about the same as 1910. Despite the recent growth of one or two individual enterprises, such as the Globe & Phœnix and the Giant, the gold mining industry is not expanding as much as current talk would lead one to infer. Meanwhile the Selukwe incident supplies a pathetic episode, for after hopes had been raised they were shattered by Mr. Ackermann's report, and now the finding of 4½ ft. of 8½ dwt. ore on the 10th level has revived expectations. Such are the vicissitudes of gold mining.

At the end of June the shareholders in Globe & Phœnix received a circular letter informing them that the mill would cease work for eight weeks pending repairs to the main shaft and at the same time some incomplete information was given concerning current developments in the mines. Meanwhile it is found that this news was known to several market operators several days before the shareholders heard of it and it is noteworthy that no mention is made of the results of exploration on the 17th or deepest level, where it is rumoured results are disappointing. It is eminently desirable that the directors should be reminded that they are trustees for the shareholders, both the minority not represented on the board and the majority controlling the company. It is, as we have said repeatedly, a serious blemish on Rhodesian mining that cablegrams should be so often cryptic and reports belated, thus affording easy opportunity for raids on the part of well informed speculators.

WEST AFRICA.—Elsewhere in this issue we refer at some length to the present conditions on the Gold Coast. Progress at the Taquah Central, which is under the management of Bewick, Moreing & Co., is proceeding rapidly. The property is situated between the Taquah and Abosso, and much of the working capital has been supplied by the Great Fingall company. The surface equipment has mostly arrived at the mine and the winding and pumping installations are being erected.

The banket deposit will in all probability be reached at 300 ft. A caving of ground in the main shaft of the Taquah mine has compelled the cessation of milling for three weeks and depressed the shares, despite excellent news in regard to mine development, for on the eighth level the lode has been cut, showing a width of 57 inches assaying 53 dwt. per ton. Thus the ore is both wider and richer than in the upper levels, and gives splendid promise of further persistence.

INDIA.—The news from the Anantapur district is encouraging, especially at the South Jibutil property, which is held under option by the Nundydroog company. Here the lode has been proved to extend to the 350 ft. level, where the ore assays 1 oz. per ton, but the average width of the lode is not yet determined. A winze from the 250 ft. level has been sunk 29 ft. through ore 3 ft. wide and assaying 2 oz. Milling commenced at the North Anantapur mine at the beginning of June. The Mysore, Nundydroog, and Ooregum companies are paying the same interim dividends as they did this time last year. At the Nundydroog the excellent developments at depth are specially noteworthy.

NEW ZEALAND.—The Waihi is not only the greatest gold mine in New Zealand but it ranks among the first five gold mining enterprises in the world, therefore the recent depreciation in the shares has caused anxiety both in Australia and London. The disappointing development on the Martha lode at the No. 9 level is the reason for the slump, but it has been pointed out by local representatives of the company that the No. 8 level went through a similar stretch of poor ground and that only a small portion of the total supposed ore-bearing territory on the ninth level has been explored. Of course, the mine would be richly productive for many years even if the lodes were to fail in the present deepest workings, for 1,335,000 tons of ore is held in reserve, but in a mine of the first rank expectations are such as to make any decline appear like a disaster. We hope the management, which is equally straightforward and efficient, will be able to prove that the impoverishment in the Martha lode is local and does not affect the other members of the vein-system, the geological character of which was clearly explained by Mr. Finlayson in our April issue.

Meanwhile the adjoining mine, the Waihi Grand Junction, is doing well and at the recent meeting the chairman announced an increase in the reserve from 91,000 tons at the end of last year to 142,000 tons at the end of June. The manager, Mr. W. F. Grace, recommends that the capacity of the milling plant be augmented to 400 tons per day. We note also with pleasure that the shareholders passed a vote of thanks to Mr. Grace for his efficient direction of their affairs. It is to be hoped that these two adjoining mines at Waihi will be able to make a mutually advantageous arrangement for pumping.

SIBERIA.—The weekly reports of the Lenskoie company, as published by the Lena Goldfields, continue to exhibit a production of gold placing this property among the great gold mines of the world. About two-fifths of the total amount of gravel brought to bank for the eight months of the financial year has been washed for a yield of £512,947, up to June 7. The yield averages 20% higher than the estimate; the actual return being not less than 49s. 4d. or considerably over half an ounce of gold per cubic yard. The season for surface work ends in October. It is probable that the total output of gold for the financial year will exceed £1,500,000.

UNITED STATES.—As much pains is now being taken at New York to allay anxiety caused by the increasing production of the 'disseminated' copper mines as was taken a few months ago to stimulate excitement. It is recognized that the promise of a flood of copper has weakened the metal market, so the controllers of the big enterprises are now

MAP OF BRITISH COLUMBIA,

Showing position of Stewart, the locality of the supposed gold discovery

sounding a different note and in a minor key. But it is not convincing. The plain fact is that as the proportion of copper produced for 8 to 9 cents increases, the impossibility of maintaining the price of the metal at 12 to 13 cents is accentuated. Only an abnormal increase of consumption, of which there is no sign, can neutralize this tendency.

The American Copper Producers' Association reports that the production during June was 127,219,188 lb., an increase of 3,976,712 lb. as compared with May. The deliveries for home consumption were 53,363,196 lb., as compared with 59,305,222 lb.; for export, 65,895,948 lb. as compared with 45,495,440 lb.; the total was 119,259,144 lb. as against 104,800,662 lb. in May.

MEXICO. — The most pleasant feature of current events is the report sent to the shareholders of the Mexico Mines of El Oro; this interim report is by Mr. R. M. Raymond, the Company's local director; it is commendable not only by reason of the satisfactory information concerning a mine possessing an exemplary history, in its flotation, management, and dividends, but in the promptitude with which the report has been transmitted to the shareholders. Here is a report sent from Mexico on June 22 actually distributed in London on July 7. Rhodesian companies please copy.

Apparently the Mexico mine has reached that interesting stage when a lower grade of ore must be broken if the output is to reflect its continued resources. Mr. Raymond warns the owners that the main lode on the sixth and seventh levels has scattered into several veins distributed over an increased width of lode-channel, so that there is less high-grade stuff but more ore of low-grade, but profitable, character. The report is delightfully frank and straightforward. An increase of £15,000 in monthly profits is promised, and an addition to plant is advised.

On another page we publish an article on the exploitation of the oil resources of Mexico, written by Mr. H. S. Denny, who has recently been on the ground. It is apparent that the coastal region adjacent to the Gulf of Mexico, like the opposite Pacific shore in California, is destined to be richly productive in liquid mineral. Much money and energy is being directed to the purpose, and like California, the Mexican oilfields also have their 'gusher' or oil-spouter, for the Dos Bocas well is in this region, about 60 miles south of Tampico and 10 miles from the Gulf shore. The well was started on April 1, 1908 and reached a depth of 1824 ft. on July 4, when the drill penetrated the oil stratum. At once the pressure of gas blew out the boring tools and casing, oil began to spout, and took fire immediately. For two months the oil was thus consumed, fully 10,000,000 barrels being lost in smoke. Finally hot water followed the oil, and then the sides of the well collapsed.

The International Congress of Mining, Metallurgy and allied sciences held at Dusseldorf during the latter days of June was a great success and the attendance numbered 1762, of whom 634 were visitors from other countries. This is the fifth session, the first three being held in Paris and the fourth in Belgium, and the interest created has gradually increased. A great many papers were presented at Dusseldorf. These are not published in a form that makes them available for reproduction in the technical Press, but they act as a useful means for inducing a free and informal interchange of opinions among those present at the meetings. Much of the discussion centred round the economy of fuel and the prevention of waste of heat and of by-products, and the subjects were more connected with coal and iron than the non-ferrous metals. However, the chief object of the Congress is not the publication of literature, but the opportunity it offers to the industrial scientists of all countries to get to know one another, to spread good-will among men, and improve the conditions of work and labour throughout the world.

EDITORIAL

AMONG the Birthday Honours we note with pleasure that Mr. Henry Hall, the Inspector of Mines, has been knighted, Mr. Alfred Mond becomes a baronet, Mr. T. W. Edgeworth David, the Australian geologist, is made a C.M.G., and Sir Weetman Pearson is ennobled. The last of these might add an Aztec touch to the peerage by adopting the style of Lord Tehuantepec.

WE NOTE with interest that the Women Writers had a dinner, attended by many known to literary fame. The chairwoman, recently returned from America, "talked with approval of the capacity of Americans for enthusiasm. The people over there were not afraid; they let themselves go individually and independently over what they liked and admired." This observant lady concluded by saying that "something of that spirit was to be prayed for in this country." We echo the prayer, but we recognize the inherent improbability of a favourable answer.

THE ELECTION of Porfirio Diaz to the Presidency of Mexico is only the proper sequel to his acceptance of renomination a year ago. When he begins his eighth term in December he will be eighty years old, and his age is scarcely less significant than the number of times he has impressed himself on the people of Mexico. An autocracy has its advantages, but continuity is not one of them. When the hand of General Diaz is taken from the lever that regulates Mexican activity a crisis is inevitable. If Señor Limantour, a Minister of Finance of whom any country might be proud, had accepted the Vice-Presidency the political future of Mexico would have seemed less uncertain, but although Señor Corral, the Vice-President, is a man of discretion, it is not too much to say that only a strong personality can hope to control a people that has lived so long under a military dictatorship in which the form and the spirit of representative government are wholly lacking.

REFERENCE was made recently in these columns to the valueless character of the anonymous reports transmitted from mines and the necessity for mentioning the name of the engineers from whom such reports emanate, both as a means of placing responsibility and of giving credit. It is with pleasure therefore that we noted in the financial papers of June 20 the cablegrams sent from the Selukwe-Columbia, Antelope, and Etna Development mines. In each case an 'office note' is appended, stating that the H. E. Jones who sends the report, "is the company's consulting engineer." Of course, Mr. H. Ewer Jones needs no introduction to the members of his own profession, but it is well that the public should know that in this case he is the man behind the gun.

ON more than one occasion the statement has been made that news concerning important developments in the Globe & Phœnix mine has reached speculators long before it was given to the shareholders. This is said to have happened on June 25 and has provoked such resentment as to lead several shareholders to demand an inquiry, under the leadership of Mr. F. A. Mitchell-Hedges. We do not know the gentleman and we have not discussed the matter with any shareholder, but viewing the episode from a detached standpoint we trust that the investigation will take place and that the directors will show no hesitation in helping an enquiry into the facts. If, as is likely, they are merely the victims of speculative enterprise on the part of outsiders they will be

absolved of complicity and at the same time they will be able to devise measures for becoming as well and as promptly informed as persons not connected with the management. The directors are trustees; the shareholders are the owners of a mine.

SEVERAL months ago we criticized the Russian official attitude to foreign mining companies and instanced the case of Mr. Jafet Lindeberg, who, while operating on a concession on the Anidir, suffered a loss of $10,000 in gold dust that was seized by Governor Kalmakoff. The sequel may now be recorded: Mr. Lindeberg went to St. Petersburg, sued the Governor and his sub-officials and got a judgment of $77,000. We congratulate the worthy representative of Scandinavian energy and Alaskan enterprise. The incident is also pleasant as indicating that justice can reach even a Governor of Siberia. In this issue we publish a letter on the subject from Mr. C. W. Purington, now on his way to Vladivostok. We note that the enterprise of British promoters in acquiring oil lands in the Caucasus has caused the Russian Government to consider the advisability of discontinuing the authorizations for exploitation issued to foreigners operating in the Maikop district. This will not affect those already in operation, but it may hinder new issues.

OUR FRIEND and contemporary, the *Canadian Mining Journal*, publishes a timely article on the Porcupine goldfield, written by Mr. W. E. H. Carter, who visited that part of Ontario in May. The description reminds us of the boom days of the Lake of the Woods when numerous quartz outcrops formed the incentive to a rush among the inundated *roches moutonnées* of a deeply glaciated region. At Porcupine the promise of a productive goldfield is better than it was in the vicinity of Rat Portage, for we gather from Mr. Carter's article that gold has been found in a large number of quartz lodes, some of which are generously wide and liberally besprinkled with the accessory minerals usually deemed favourable to the existence of persistent veins. So far the energies of prospectors have been devoted to locating claims, but in the near future the actual work of digging will disclose the facts necessary to a decisive opinion on the future of the district. We hope to receive good news.

SEVERAL ATTEMPTS have been made to capitalize the romance of radium. One of these is the National Radium Trust, the pretentious name of which in itself should act as a warning to speculators. Of course, uranium minerals are the source of radium, but all uranium compounds do not contain radium, and, as far as known, the distribution of the latter is most uncertain. Therefore the exploitation of radio-active ore is not suitable for company finance or public investment. It is best left to small syndicates or individuals of adventurous spirit. The report gives particulars concerning only three out of the 23 mining properties in Portugal, to operate which the Trust is formed. It is assumed that a profit of £9600 can be made from "the hire of one gramme of radium for 40 days." Thus the rental value of one gramme is rated at £86,400 per annum, the ownership resting in the company. It is assumed that 1% of uranium oxide can be extracted without loss and that sodium uranate will not fall below 20 francs per kilogram. Such assumptions are unsound.

THE PRESIDENT of the Board of Trade was asked by Mr. Arthur Fell, in the House of Commons, for information concerning the production of gold in the world and responded by quoting the Director of the American Mint, giving however no later statistics than those for 1907 and 1908. In a matter of this kind only up-to-date information has any practical value. We have sent to Mr.

Buxton, the President of the Board of Trade, and to his enquirer, a copy of our last issue, in which the needed information is fully given. We note also that even so enterprising a paper as the *Daily Telegraph*, in publishing despatches concerning the gold discovery in Canada, states that 1907 is the "latest year" for which figures of the world's gold production are available and after giving totals for the British dominions, it adds that "the total value of Greater Britain's output was about £51,240,000" in 1907. As it is true that the Empire produces two-thirds of the world's annual gold supply, it is remarkable that a Government department and our most enterprising newspaper should both be so lacking in accurate information on the subject. As regards the Canadian excitement, the locality of which puzzled the daily Press, our readers will have noted that in our June issue, under the general review of mining, we referred to the rush to the mining region tributary to the Portland Canal and mentioned Stewart as a new town to which 10,000 people had already been attracted by the news of mineral discovery.

El Dorado.

Once again the call of the prospector has thrilled the adventurous; when the story of a wonderful discovery in British Columbia was telegraphed across the world the ploughman stopped in his unfinished furrow, the clerk laid down his pen, and the capitalist sought for a map, all quickened by the siren voice that has lured the race to the search for gold from time immemorial. As yet, however, the news is not confirmed. On June 15 it was announced at Toronto that a big find had been made at Bitter Creek, 17 miles from Stewart, a new settlement on the Portland Canal. On June 26 despatches were received in London stating that a rich lode of gold ore had been traced for 20 miles; indeed, there was no end to it, so that 1000 stamps could be supplied with ore for 100 years; in short, it was "the greatest mineral discovery ever made." All of which is interesting, if true. It is remarkable how eagerly such strong statements were accepted at their face value, and how quickly syndicates and parties were organized in London to send experienced men to the locality of the new goldfield. Yet stories of a similar kind can be read in the American Press at least once a month; mountains of ore, veins as wide as a street and as persistent as a railway line, samples as rich as a jeweller's store, and prospects as fabulous as Alladin's cave are the familiar ingredients of the 'story' compiled at recurrent intervals by pressmen aching for sensational journalism. We recognize the improbability, yet we find it difficult to sift fact from fancy, for the improbable has proved the commonplace more than once, as at Johannesburg, at Kalgoorlie, at Cripple Creek, and at a score of places whose glittering names are now firmly inscribed on the map of mineral exploration. Why should not a gold vein be found bigger and richer than any recorded in history; why should not a mass of gold equal in value to the National Debt be disclosed in some distant mountain or uncovered amid the tremulous atmosphere of some burning desert? After all, the quantity of gold assumed to be in such a treasure trove would be small in proportion to the scope of Nature's operations; it would be less than the masses of iron ore exploited in Minnesota and Spain, and it would be reasonable as compared to the bodies of native copper mined in Michigan. The largest mass of native copper ever discovered weighed 420 tons, which would have been worth £50,000,000 if it had been gold. And if native copper exists in such quantity, why not gold, in even greater quantity? No obvious reason exists, except the inference from experience. We infer that the distribution of gold in nature is not so generous as that of copper or iron, simply because the prospecting of two thousand years has dispelled the hope of anything so lavish. For this there

is also a scientific explanation in the greater instability of gold solutions, rendering it unlikely that conditions favouring precipitation will persist long enough in one spot to permit of an accumulation as big as that in which Nature collects the baser metals. However, that is another story. The plain truth is that we judge as to what may happen by what has happened. Great bodies of gold ore are scarce, big stories concerning the finding of them are common, therefore we expect to hear the latter with frequency and to find the former at rare intervals.

In this Magazine we have recorded, from time to time, the news of mineral discoveries along the line of the Grand Trunk Pacific railway, whose terminus is at Rupert, about 400 miles north of Vancouver. From the railway the prospector has spread into the coast range, which is indented by long bays or fiords giving easy access by water. One of these fiords is the Portland Canal, a wide lane of water forming the boundary between British Columbia and Alaska. At the upper end of this waterway the Bear river enters and there the mining settlement of Stewart has been formed. As early as 1898 gold was found in the vicinity. In 1903 a recorder's office was opened at this locality and a trail was built by the Government up the Bear valley to Glacier creek. In 1906 the Provincial Assayer, Mr. H. Carmichael, visited the prospects on Glacier and Bitter creeks, and made a favourable report, the immediate result of which was the construction of a bridge over the Bear River. We publish a map showing the position of the district, which is reached either overland from Hazleton or by water from Prince Rupert. It is stated that 15,000 people passed through the Portland Canal in June and that the population of Prince Rupert 'stampeded' to the new 'excitement' without delay. We shall soon receive authentic information, for scores of experienced men are on their way thither and will be transmitting reliable reports. In the meantime two facts are worth noting: in the first place, the district is so close to the Alaskan line that part of it is likely to be in American territory and thus cause complications as to tenure, for the locations laws of the United States are based on apex rights while those of British Columbia recognize vertical limits. It will not be the first time that valuable mineral discoveries have been made near an international boundary, for example, in the Yukon. Next, it can be stated that the finding of valuable ore deposits at Bitter Creek, Bear River, or Stewart, whatever name may be given to the goldfield, whether important or not, is in keeping with reasonable expectation, for the locality is in the Alaskan range, which is characterized by a belt of schistose rocks, in which, for example, the Treadwell mines have been exploited, together with other less famous but highly productive properties. It is recognized among mining geologists at all familiar with the Pacific coast that from Vancouver to Skagway the Alaskan range affords excellent chances for the finding of ore deposits valuable for gold and copper. Thus, whatever the immediate result of the 'rush' may prove to be, it is certain that it will give a stimulus to the prospecting already facilitated by the building of the Grand Trunk Pacific railway.

To Graduates, and Others.

At this season of the year the Schools of Mines and other technical colleges are sending forth hundreds of young men to start their careers as mining engineers, metallurgists, and economic geologists. To them we venture to give something the value of which depends on the appraisal by the recipient, namely, advice. They are about to step into the domain of industry and to take a manly part in a competition the severity of which has been made more intense by every improvement in material civilization, for it is obvious that whereas in the olden time a young man had only to com-

pete with his neighbours, in these days the railway, the steamship, and the telegraph have so greatly facilitated both migration and exchange of thought as to make the habitable world one wide field of activity. As regards English-speaking countries, at least, the barriers of distance have been removed so that the young men of Great Britain compete with those of America, and those of Canada with their cousins in Australia or South Africa. And the competition has been intensified by the larger number of capable men trained at the numerous technical colleges, for localities hardly on the map fifty years ago now possess excellent Schools of Mines sending forth engineers and geologists quite able to hold their own against the product of the old centres of learning. In short, in professional life, as in human life generally, not only has the struggle for existence become more fierce but the contest for the means of enjoyment has become more acute. Therefore, those who are about to begin serious work should consider the aim and purpose of their labour.

It is said that at forty a man is either a philosopher or a fool; which means that he is then old enough to have some idea of the direction in which he is voyaging and the character of the port for which his sails are set. But it is not necessary to wait until a man is forty in order to have a serious purpose. It will be well for the voyager if he consult his charts and adjust his compass before he sets sail. As one who has been to sea—if not 'at sea'—for a time long enough to have travelled more than half-way to port, we venture to point a finger at two or three places marked on the chart that has been left to us by those who have gone before. In the first place, we live in the midst of a scheme of creation not chosen by us; we are amenable to laws—human, natural, and possibly super-natural—in the making of which we have had no say. They are facts, and the engineer's first instinct is to recognize facts as unalterable and ineradicable. This scheme of creation is called modern civilization; we are the unconsidered units in a vast system evolved from the interplay of cosmic and ethical forces. It is for us to make the best of the game into which we have been flung, to play to win, and to play so that the winning shall be a source of happiness to ourselves and to others. Presumably it is the aim of men to be happy, and to be happy by being useful. Happiness in the world as we find it is only obtainable by mental sanity; only by discipline of the mind and control of the body can we adapt ourselves to the environment in which the human species is cast. We speak as an engineer to engineers. Ideas of happiness are as diverse as the points of the compass, but we are discussing the matter from the viewpoint of men trained in science and occupied in technology. Our profession has ideals, far ahead; it is surrounded by actualities opposed to those ideals. It is for us to take things as they are, and make the best of them. In a period when success is too much measured by the rough standard of wealth there is danger of young men looking to money as the one prize worth winning. We shall not repeat the common cant concerning the corrupting influence of money; it might be better if worth and success could be measured by a finer standard, but they are not usually so measured simply because men strive for power, and power nowadays can be exercised most readily through the possession of wealth, just as in other days power depended on a strong arm and a good sword. But the engineer is not only a member of the genus *Homo*, he belongs to the species *Sapiens;* as such he ought to know that money is a means, not an end, and that while he wants to escape from the degradation of dependence through poverty he also should avoid the slavery incidental to wealth. Man does not live by bread alone, nor can he subsist on Dead Sea apples. His education has created new wants. If that education has been thorough the student's best faculties will have been drawn out or stimulated so as to create

desires beyond the mere winning of a bread and butter dependency or the command of a satiating luxury. His wits will have been sharpened and his mind developed. For ever thereafter, unless he be drugged by alcoholism or enervated by disease, he will demand more than the satisfaction of the bare physical wants. He is not a hod-carrier, but an architect. He is a professional man, which means that he does his work not for pay alone but for the love of the work, and for the love of doing it well. He does not work by whistle time.

Most men of consistent aim achieve their purpose. Given good health and moderate brain power, a man can win his way to any reasonable goal of ambition. But he must be consistent; he must not be diverted nor delayed, for the only way to reach a distination is to keep on going toward it. Therefore it may be well to choose the destination; in other words, not to drift, but to steer. Our observation goes to show that the engineering type of man can do best by sticking to his profession and abstaining from the excitement of financial speculation. Straight professional work is amply remunerative in these days and when it ceases to be so to an individual it is usually because he has surrendered his judgment to the fever of gambling. As he gets older he may become the associate of financiers and he may be called upon to participate with them. By that time he will have acquired sufficient experience to avoid pitfalls. Moreover, he will have learned by observation, if not by experience, that excessive wealth is won at a price, which may be a lowered self-respect, a loss of independence, or ill health. He will also have observed—we hope by observation only—that poverty militates against self-respect, and is apt to mean dependence, but not ill health, unless the poverty be abject. He will see that the extremes of life are best avoided, whether it be the swamps of pauperism or the cold and gusty heights of excessive opulence. Let him not sell his manhood for the shekels nor barter his health for refined gold. Those that get deeply immersed in the making of money usually have to do both; everything has its price. Life is an eternal illustration of compensation, and only moderation can escape the penalty of a glaring contrast. But our young men of today resemble their predecessors in impatience of a sermon, especially if it be long. Therefore we summarize a simple bit of advice by saying, in words borrowed from Edmund Garrett, that there are two things in life that are worth while: the first is friends, and the second is the sense of active efficiency.

Stope-Drill Competition.

The preliminary official report relating to the stope-drill competition at Johannesburg has now been published and the various unofficial statements have at last been superseded by an authoritative announcement. The first competition, in 1907, was unsatisfactory because the Gordon hammer-drill, which won the prize, proved subsequently to be quite unsuitable for every-day work over any prolonged period. In consequence, the conditions for the second competition, which commenced in May of last year, were altered, and lengthy periods of actual work were allotted to the drills that survived preliminary tests. Twenty-three machines were entered and 19 arrived at Johannesburg. Trials at the University College and at the Ferreira Deep mine eliminated nine, and the remaining ten were sent to do actual stoping work in the Cason, Crown Reef, Robinson Deep, and Village Deep mines, the stopes where the work was done varying from 24 to 45 inches in width. During the progress of this test six withdrew, leaving only the two Holman, the Siskol, and the Chersen to complete the competition. The eventual result was that the Holman 2⅛ in. and the Siskol were declared equal in merit, the first and second prizes being divided between them. The others finishing were the Holman 2¾ in. and the Chersen. As regards

the comparative merits of the winners, the Siskol was found to drill more rapidly than the Holman 2⅛ in. machine, but proved more expensive in renewals due to wear and tear. The cost of drilling by the Holman 2⅛ in. was 9·77 pence and by the Siskol 9·9d. per foot. This compares with 13d., the figure assumed as the cost of hand-drilling, not to mention the saving in time and the consequent saving of interest on capital.

Other facts in connection with the competition must be noted. The hammer-drills were quite outclassed, owing largely to the difficulty of withdrawing the tool. During the final trials in the stopes, the air-pressure available was not always up to standard owing to the overloading of the compressors. It has also to be remembered that no improvements in construction were permitted during the trials. This is important, as in more than one case defects were made apparent and methods of remedying them were devised while the competition was in progress. Consequently all the drills had not the form that they may eventually assume. It is of interest to mention that of the winners, the Holman comes from Cornwall, the Siskol from Yorkshire, and the Chersen from the Transvaal. The Siskol, however, is based on a German invention, first modified for English coal-mining practice.

The report of the committee contains the interesting statement that these drills cannot be operated by one man as was at first supposed. The average labour required has been found to be five natives to two drills with one white overseer. Probably the latter could supervise the operation of four drills, but that does not affect the main question. In the competition the maximum weight was limited to 100 pounds on the assumption that it was a case of 'one man, one machine'; but as this expectation has not been fulfilled the committee is of opinion that the weight could with advantage be increased to 130 pounds, thus getting more work out of the drill without increasing the labour required. Furthermore, the committee expresses the opinion that great length of hole is not a primary requirement, for the double reason that much of the work to be performed by the drills will be in a downward direction and that narrow stopes are to be encouraged.

The value of the competition to the mining industry has not been confined to the official choice of the best drill, for this point is not actually settled; nor were the conditions of work exactly the same as they would be in trials by individual mine managers in their own mines, because the drills were operated by independent drill-men appointed by the committee and not by men possessing special training in each particular drill. A specialist can show his machine to better advantage than an outsider, and, if his machine is adopted, can train the men at the mine to follow in his footsteps. While therefore the verdict of the committee will not be adopted unreservedly, it is recognized that the trials have helped the mining industry by encouraging drill-makers to put thought and energy into their designs and by giving mine-managers a practical demonstration of the possibilities of small machines.

Apart, however, from the immediate advantage of a serious attempt to ascertain the capabilities of various drills, it is probable that the introduction of these small machines will lead the way for a general re-organization of mining methods on the Rand. We are not unmindful of the many valuable advances in mining practice introduced during recent years, nor do we forget that the gigantic scale of operations and the difficulty of finding sufficient labour of a suitable kind have re-acted upon each other in such a way as to give engineers sufficient problems to occupy their attention without affording them a chance to study the economics of mining from a general standpoint. The technologist on the surface by comparison has been untrammelled and has

been free to devote a greater share of his attention to the study of metallurgical problems. Consequently metallurgical practice is ahead of mining practice, and it may even be said that the latter is under the thumb of the former. The mine has had to conform to the requirements of the metallurgical plant. Hitherto the underground manager has found it difficult to pick and choose his ore, and has been disinclined, both for reasons of personal convenience and on account of the difficulty of operating a big drill, to work in a narrow stope. The metallurgists on the surface encouraged a large tonnage and did not object to a lower average content. Hence the convenience of breaking the maximum amount of ore was mutual. Incidentally, both parties shared in the glories of low cost per ton. But it has now become recognized that large tonnages are not an unalloyed blessing and it has been shown that by narrower stoping, more careful selection of ore, and sorting at surface, equal profits can be made with a smaller metallurgical plant. Not only could the same profits be obtained with a smaller expenditure of capital, but the amount of space required on the surface would be less, and it would be easier to utilize smaller amounts of tailing for filling the exhausted stopes. Two difficulties stand in the way of making an alteration in the system of mining and metallurgy: In the first place, shareholders, and the public generally, are likely to misunderstand the policy of hanging up some of the stamps; secondly, engineers are disinclined to admit that their past policy was not ideal. It seems to us that the advent of the stope-drill gives the opportunity, both real and sentimental, for changing the mining method. To say that with the new drills it is possible to use a narrower stope and so leave behind much of the rock with low content that was hitherto mined affords a valid and cogent argument capable of being comprehended by the public, and allows the mine manager to change his methods without obloquy. In other words, to alter a system without the introduction of any new factor is a policy difficult of explanation to the public, but once a new factor is available, the altered situation is made intelligible. This illustrates the sentimental value of the stope-drill competition; the more practical result is the relief afforded to the labour stringency. If the stope-drill will reduce the number of native labourers employed underground for a given tonnage by 30%, and at the same time reduce the cost of mining, its economic importance to the welfare of the Rand is plain. For all these reasons we consider that the expenditure of £17,500 on the trials by the Transvaal Government and the Johannesburg Chamber of Mines has been one of the best investments ever made in South Africa.

Sulphuric Acid at Ducktown.

We have often referred to the progress of the campaign in America against the emission of noxious gases and fume from smelters. The cases hitherto specified by us have been in connection with smelters in California and Utah, but the agitation has not been confined to the Western States; the legislatures of Tennessee and Georgia have also been active. The Ducktown smelter belongs to an English company; it is situated in Tennessee, on the Georgia boundary line, and the latter State has evinced marked objection to sulphuric emanations. The Ducktown company is noted for researches and trials in connection with pyrite smelting; for some years also experiments were tried with a view to recovering sulphur from the smelter smoke. It was generally supposed that the chamber process would not work satisfactorily owing to the extreme dilution of the gases, and the cost of the necessary plant being great, this means of diminishing the nuisance was not considered justifiable. Attempts were then made to utilize processes requiring less outlay for an experimental plant, and the ferric oxide contact pro-

cess was provisionally adopted. It was soon found, however, that the gases were far too dilute for the reaction involved, and the experience of European chemists was thus confirmed, namely, that for contact processes the acid gas must be particularly strong and pure. Probably the idea of saving the sulphuric acid would then have been abandoned, at least for a time. Compulsion gave a different complexion to the economic problem, and as something had to be done, it was decided to embark on the construction of a chamber plant. This was completed a year ago and is described in an article abstracted in our Précis of Technology. The results are stated to be satisfactory to a degree far beyond expectations, and the designer Mr. N. L. Heinz is congratulated on the success of the venture.

Several features of the design and working of the plant will surprise the European chemist, and a more detailed discussion of the process will undoubtedly be demanded. The most notable point is that the same capacity of chamber is employed as if the richest gas obtained by burning pure sulphur or high-grade pyrite were being treated. The sulphur content of the daily production quoted in the article, 160 tons of 60° B, is approximately 40 tons. This only allows a chamber capacity of 13 cubic feet per pound of sulphur burnt per day, as compared with 15 cubic feet usually allowed in European plants when rich gas is evolved from high-grade material. Seeing that the sulphurous gas contained in the Ducktown smelter smoke is only 3½%, the efficiency of the chamber reaction is remarkable, and is hardly to be credited at first sight. The performance therefore deserves a wider advertisement throughout the chemical and metallurgical world. Another point to which we would draw attention is the fact that the influence of carbonic acid in the gases has been overcome. The authors of the article quoted do not say what the nature of the difficulty is or how it is obviated, as the new method is at present a secret. We may say, however, that the efficiency of the chamber process requires a continuous contact between the sulphurous vapours and the acid lying on the floor of the chamber. Carbonic acid acts injuriously by settling as an inert layer over this bottom acid and prevents the necessary contact. Probably the secret method of treatment involves an agitation of the gases, so preventing the settlement of the carbonic acid on the floor of the chamber. With regard to the removal of the dust, additional information would be acceptable. It is easy enough to remove it by cooling the gases, but too much cooling is not desirable, because the Glover towers will not then work efficiently. If the gases entering the tower are of less temperature than 150° C, denitration does not take place. It is a difficult problem to cool the gas sufficiently to deposit the dust and yet maintain it high enough for the Glover tower. It would therefore be of interest to know the temperatures in the Ducktown plant at the following four points: exit of blast-furnace, inlet of dust-catcher, outlet of the same, and inlet of the Glover tower. Such information would be useful to others who desire to follow on the same lines.

That the engineers and chemists who designed the plant, or who were interested in the production of acid from smelter gases, were working more or less in the dark, may be inferred from the fact that they did not expect to produce a pure acid but only a sludge. The fact is that the dust in the gases would never get as far as liquid acid, so no sludge acid could be made. Unless the dust is entirely removed it would have the effect of immediately stopping the action of the Glover tower, with the consequence that the production of sulphuric acid of any sort would come to a standstill. If acid is produced at all it is bound to be reasonably pure. In conclusion, we would say again that the results are sufficiently surprising to cause some doubt as to the correctness of the figures given in the article,

and for this reason we ask, in the interest of smelters who desire to save their gases, that the engineers and chemists of the Ducktown company should supplement the information already published.

Mixed American.

Among the prospectuses issued in June is that of the Mexamerican Company. We have read it with keen interest, for it has reminded us of a bygone era. In the first place, the company is incorporated under the laws of Arizona. What does the average Britisher know about the laws of Arizona? He may be pardoned for assuming that a mine in Colorado, to be owned by a company financed in London, is incorporated in Arizona in order to evade legal obligations incidental to incorporation either in the State where the mine is or in the country where the new owners are. But the company having been incorporated in Arizona, we wonder how the prospectus can have been filed with the Registrar of Joint Stock Companies, as is claimed on the first page of that document. According to established regulations such registration would require disclosure of contracts and other information of a highly pertinent character, all of which is lacking in the prospectus in question. The mine is in a picturesque part of Colorado and in a region rich in the romance of discovery. So many reliable sources of information concerning the locality were available that we marvel at the nature of those to which reference is made. For instance, the Hinsdale County Publicity Association is quoted as saying that "the metallic wealth of the region is phenomenal." This is worthy of an organization of 'boosters,' but it is hardly germane to the value of a particular mine. We are informed next that this mining district is "the home of true fissures," as if the poor old 'true fissure' were not as dead as a labyrinthodont. Then comes the familiar reference to the plentifulness of wood and timber, as if a rich mine in a desert were not better than a poor one in the midst of murmuring forests and laughing streams. Wood and water are well enough if you have plenty of profitable ore, otherwise they serve only to decorate a pathetic *mise en scène*. As to the ore in reserve we have 'particulars' from a gentleman who possesses "the endorsement of every Governor of Colorado since its admission as a State in 1876." Having known some of the governors of Colorado, almost intimately, we can say that the comprehensiveness of the endorsement militates against the reliability of it. Another authority quoted is a worthy metallurgist long since dead; and a third is an editor, of whom we can only say that the nature of his occupation is not entirely conducive to a capacity for appraising mines. Among others "recommending the property" are worthy citizens scattered all over the United States, most of whom are unknown to fame, and, what is more important, entirely unknown to the people who are expected to subscribe to the issue of Mexamerican shares. The report on the mine by a gentleman having the suffix of M.E. is characterized by the delicious trimmings of technology, as an old lady called them. We are told concerning the "actual proven length of the paystreak" and "the estimated proven length of Vein Matter," and we are asked to believe that both statements are "exceeding conservative." Assays are quoted as having been made by the Denver *Mining Record* and by a correspondent of the *United States Investor*, at Boston, and it will be obvious what exceptional facilities for assaying usually exist in a newspaper office. The mill contains a Frazier & Chalmers dryer and is connected to the mine by a Swancable tramway; evidently all that is needed is an Argyle roaster and a Butter filter. However, there is a "stamping room," which is provided for those that may feel annoyed. The prospectus states that a former Commissioner of Mines "found the Black Wonder vein al-

most perpendicular"; we wonder that he did not find it all askew, for it (the vein, not the Commissioner) must have been inebriated by the exuberance of its mineralogical contents, seeing that "the ore is composed of quartz, quartzite, flour spar, silver glance, brittle silver, black sulphurets," and no end of things. We are reminded of our old friend Professor Murphy, whose dictum in such matters was final in Dead Horse gulch. When asked to determine the nature of a specimen of ore broken from a "metamorphic matrix of a somewhat argillo-arenaceous composition," he said: "It is hoighly meglaferous maaterial, bedad; and its chief component parts is composed of zinc, lead, iron, and tin, and the horns of silver and iron pirate and copper ox hide, and the Devil knows what all, and where did ye get it, that I may go and locate it?" However, even our illustrious old friend would have been astonished at the Mexamerican mine and its "inexhaustible true fissure." He would have keenly appreciated the observation made by Mr. Wilkins: "Mineral, the name of the county which forms the eastern boundary of Hinsdale county, is, in itself, sufficient indication of the wealth recovered from its hills and canyons." We never thought of that; of course, it is obvious. "The study of this county provides ample scope for discussion." That's the idea, give the London shareholders lots of discussion; they love it. Especially about "the gold bearing chimneys" and "the extensive slides," which suggest extremes of temperature highly appropriate to a "deeply scored volcanic plateau" in which "high winds and torrential downpours" have caused "heavy erosions." The same Mr. Wilkins, of Finsbury Pavement House, London, states that the evidence amply indicates "the existence of rich porphoritic fissures, such as I have described in the Telluride District." Fortunately we have missed that description, and we may be pardoned for hoping that it may remain in the Telluride district, preferably above timberline. "These fissures," we are told by the gentleman conversant with the gold-bearing pavement of Finsbury, "always yield a good return on capital invested under efficient management." That is what we have so long wanted to know; obviously to become rich first catch your "porphoritic fissure" and then your "efficient management," and the rest is easy.

However, if you are not convinced even by the encyclopedic information conveyed by the prospectus you will turn to the personnel of the advisory committee. One of them is the Deputy Lieutenant of Norfolk and a Member of the Victorian Order, another is a Colonel and a C. V. O., while the third is the son of a peer; of course, each of the prefixes, suffixes, and titles attached to these three worthy gentleman indicates their particular fitness to advise the untechnical public in the mining, metallurgy, geology, and especially the business, incidental to the operations of the Mexamerican company.

West Africa.

From an experienced mining engineer recently returned from the Gold Coast we gain a favourable impression of the progress being made in that gold-mining region. Development of substantial character is now the rule on properties that have passed beyond the prospect stage. Active exploration is in progress on many concessions that have recently been acquired or have been lying idle until now; in short, there is less of concession hunting and more real work than for some time past. Apparently the interest excited in banket or conglomerate deposits has hindered the exploitation of the quartz veins, which are full of promise. Concessionaires and promoters have given more particular attention to the 'banket' because of the halo in which the public is disposed to envelop that word. In many minds 'banket' conveys the erroneous suggestion of continuous and profitable ore-shoots easily

translated into dividends, hence the reason for the prominence given to this class of mining property as compared to others traversed by mere veins of quartz. The immediate result of the search for banket has been a rapid widening of possible mining territory. Ore of commercial value has been found on the Wallis ground and it is possible that other points between this and the Taquah lode will produce ore of equal grade. The daily Press on several occasions recently has pointed to the fact that the Taquah and Wallis ' reefs ' were identical, hence the territory between them must contain the same lode, probably with the same kind of ore. These two beds of gold-bearing conglomerate do belong to the same geological group, they may have been formed at the same time, they have a number of points of resemblance, but in many respects they are dissimilar. There is absolutely no proof that they are identical, nor does it follow that the territory between them is of commercial importance. That remains to be proved. Many layers of conglomerate, coarse sandstone, and true banket have been found parallel to and northwest of the Taquah and Wallis ranges, but up to the present they have not been tested conclusively. It is too readily assumed that all banket is ore ; but as it takes more than one swallow to make a summer so it needs more than one good sample to indicate a mine. The banket that is to serve as the basis for profitable industry must contain not only gold, but gold in quantity more than sufficient to defray the cost of extraction. Ore of this grade, however, is already sufficiently plentiful to warrant vigorous development on the Taquah range ; the Abbontiakoon mine has two feet of 1½ oz. ore at a depth of 2065 feet on the lode or 1150 feet vertical, the Taquah has 5 feet of 2½ oz. ore at 1160 feet, while the Abosso and Cinnamon Bippo are mines that are now beyond the preliminary stages of development. As mining progresses and promotion diminishes, quartz veins are attracting more attention. The Prestea range is active throughout its known length, as is also the country surrounding the Obuasi, which is probably on the same vein system. A number of prospectors are working outside of this belt and indications certainly point to the opening of several substantial mines. In vein mining the Ashanti Goldfields has taken the lead, the deepest workings at 800 feet exposing rich ore. Prestea Block A is a close second, while some of its neighbours are not far behind.

Progress is slow, as it must be in a country in want of railways and dowered with a bad climate, but shareholders can afford to be patient. Some irritation is expressed in the financial Press by writers who rush into print in order to accentuate facts favourable to companies in which they have shares, and the price of which is languishing. The boom in West Africans, it is true, suffered from an early frost, but the check to inflation was most fortunate, viewing the matter in the interest of the larger public, for if it had been continued a big loss would have been suffered by the many as against the immediate gain to the few. Big mining enterprises cannot be set going in a jungle at short notice ; time, as well as money, must be expended. The climate possibly is not as bad as some paint it, but neither is it as good as others describe it. Inevitably, it is and will continue to be relaxing. White men lose energy easily in the damp heat and need a change of air. Eight months of continuous work is enough for the most willing of men, which means that two managers, alternating and overlapping, are required to ensure a vigorous and continuous policy. Some men take bad climates with them in their whisky flasks and several promising careers have been destroyed by the alcoholism incidental to exile and poor food. A large percentage of deaths on the West Coast may be attributed, directly or indirectly, to the excessive use of stimulants ; there seems no medical objection to the use of them in moderation, but such over-in-

dulgence as is seen every day on the West Coast would kill men even in a temperate climate. Yellow fever, which recently caused a mild scare at Sekondi, is present in the coast villages, some authorities claiming that it is never entirely eradicated. Be this as it may, there is little probability of infection spreading to the more important mining centres, although it may hinder operations occasionally by closing ports of entry into the country. With proper precaution against the effects of sun and whisky, it is possible to combat fever and to remain physically capable, but only by the tonic aid of a frequent return to a climate normal to the European. Directors may as well recognize this fact and not attempt to be thrifty by over-working their staff. No improvidence is less regrettable than squandering the health of useful men. And to these latter we also venture to say that they in turn should help each other. We hear reports of lack of co-operation, to put it mildly. Managers of adjacent mines, exploiting ore-shoots that cross their common boundaries, refuse to exchange information. It may be the shadow of the Stock Exchange that falls across the jungle, it may be only the secretiveness of the small mind or the unenlightened selfishness of the ignorant, but, whatever the cause, it is obvious that money, time, and labour can be conserved by the exchange of ideas and information. If one manager tries gas-engines, another filter-presses, or a third stoping-drills, why not make known the results of such experiments to the gain of all. The man who contributes most in this regard is likely to be most benefited in the long run. Even the mine manager living in a wilderness need not make his office an island of uncommunicativeness. In this regard the Rand now affords a splendid example of helpfulness and co-operation.

Scarcity of labour is said to be hampering operations. Only one management, that of the Ashanti Goldfields, has had the foresight to make such adequate arrangements as to be now fully provided with workmen. The aborigines in their untutored state are unwilling to work, because they can obtain all the necessaries of life for a minimum of labour. In this they resemble other dark-skinned races whose wants are simple. But as the country becomes civilized, the natives will acquire new tastes and will develop a desire for luxuries hitherto withheld; then they will feel the lack of money, by which only can such desires be gratified, and thus finally they will consent to perform manual labour for wages. Much will depend upon the manner in which men are recruited and treated; in this regard the experience of the Rand and Rhodesia ought to be helpful. An adequate source of supply exists and it needs but to be tapped carefully. The problem is vital to the progress of the industry of West Africa. On the solution of it depends economic success in mining. As in technical matters, the proper solution will be reached least expensively and most rapidly by co-operation between the managers. A long pull, a strong pull, and a pull all together is as useful on the Ankobra and the Prah as on the Thames.

The Efficiency of Concentration.

In estimating the efficiency of any concentration process the usual plan is first to weigh the ore and the concentrate produced and then ascertain the percentage of metal contained in samples of both. The ratio of concentration is the weight of the ore divided by that of the concentrate. The extraction is the percentage of the total metal transferred from the ore to the concentrate; it is determined by multiplying the percentage of the metal in the concentrate by the weight of the concentrate, dividing by the product of the percentage of metal in the ore by the weight of ore, and multiplying the quotient by 100. Thus if x and y are the weights of the ore and concentrate, and a and b the percentage assays,

then $\frac{x}{y}$ is the ratio of concentration, and $\frac{100\,by}{ax}$ is the percentage of extraction. To obtain these figures in practice it is only necessary to weigh the ore delivered and the concentrate produced during a definite period and to assay samples of both. It is not generally known that these two items of information can be obtained without weighing the ore and concentrate. In fact, most mining engineers at first sight might even ridicule the mention of such a possibility. But it is nevertheless a fact. The method has been described in an article, of which an abstract appears in our Précis of Technology, by Mr. Theodore J. Hoover.

In problems of concentration there are six variables: the weights of the ore, concentrate, and tailing, and the weights of the metal in the ore, concentrate, and tailing. As the latter three are not capable of direct measurement we substitute the percentage content of each as ascertained by sampling. These percentages multiplied by the respective weights give the metal contents. If we take x, y, and z as the weights of the ore, concentrate, and tailing, and a, b, and c as the percentages of metal content, then the equation of the weights of ore, concentrate, and tailing is $x=y+z$, and the equation of the weights of the metal content is $ax=by+cz$. Here we have a simple mathematical proposition of six variables and two equations. It follows that if we know the value of any four we can calculate the other two, and that if we know three we can calculate certain ratios.

In the Précis we show how to deduce the value of the ratios $\frac{x}{y}$ and $\frac{100\,by}{ax}$ in terms of known quantities a, b, and c: that is, how to find the ratio of concentration and the percentage of extraction when knowing only the assay-percentage of the ore, concentrate, and tailing. We need not reproduce the working here, but simply record that the ratio of concentration is expressed by $\frac{b-c}{a-c}$, and the percentage of extraction by $\frac{100\,b\,(a-c)}{a\,(b-c)}$. A concrete example will help to elucidate. Samples of the ore, concentrate, and tailing give 5%, 20%, and 1% of metal. The ratio of concentration is $\frac{20-1}{5-1}=\frac{19}{4}=4\frac{3}{4}:1$; and the percentage of extraction is $\frac{100\times 20\,(5-1)}{5\,(20-1)}$ or 84·2%.

Thus we obtain the ratio of concentration and the percentage of extraction by sampling without weighing. We can go further and calculate the weight of tailing and concentrate produced from a given weight of ore, say 100 tons. The amount of concentrate y is obtained by dividing x by the ratio of concentration, and the tailing z by substracting y from 100. In the example given above, the ratio of concentration is $4\frac{3}{4}:1$; so y, the weight of concentrate produced, is 21 tons; by substracting, z, the weight of tailing, is found to be 79 tons.

The same formulas and equations hold good if ounces or pennyweights per ton are used instead of percentages. The percentage of gold per ton is obtained by multiplying the ounces or pennyweights by the constant representing the percentage that one ounce or pennyweight bears to 2240 pounds. As this constant appears in both numerator and denominator of the ratios and on both sides of the equation, it can be cancelled, and it thus disappears, leaving the number of ounces or pennyweights to do duty for the percentage.

One advantage of such formulas is that the percentage of extraction can at any time be determined without measuring the result of the day's work. Another is that it gives opportunities of arriving at the results by two different ways, and thus affords a check on the assayers, samplers, and weighers. A third is that by means of these formulas and equations the whole subject of accuracy of assay and measurement, and the effect of various errors, can be studied. We have asked Mr. Hoover to amplify this phase of the subject and we hope to present an article by him in an early issue.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

MELBOURNE.

Siamese Tin.—The most interesting event for some time past has been the condemnation of the property of the Tongkah Harbour Tin Dredging Co. in Siam by the experts sent to examine it. These comprised David Currie, of Lake & Currie, London, J. L. Wharton, of Melbourne, and D. G. Henry, the last being a mechanical engineer. Mr. Wharton's report has been sent to the directors and has been published. The first thing done was to examine the physical characteristics of the wash. This was done by means of bores, 60 being sunk in different parts of the harbour at depths ranging from 4 ft. to over 30 ft. It was found that the wash carried more titaniferous iron as the distance from the shore increased. The tin also was finer. Mr. Wharton computed that the quantity of tin-bearing ground is 13,000,000 cu. yd. At 0·75 lb. per cu. yd. with costs at 6d. per cu. yd., after allowing for the capital cost (£23,000) of two new dredges, repairs to the present plant £6000 and £23,000 for commutation of the company's dock scheme, this would leave a profit on the whole undertaking of £1166, with tin at £150 per ton; or a loss of £25,917, with tin at £140. This opinion has been challenged by the directors and by their representative, Captain Miles, it being asserted that the three experts did not personally supervise the boring, and that they only put down 16 holes. It is claimed that the No. 3 dredge, which is working farthest from the land, in twelve months gave a return of 1·512 lb. per cu. yd. or double what Mr. Wharton estimates. There is some conflict over the records of boring done in the early days of the venture. Mr. Wharton stated that these were not available at the mine and that he had been informed that they had been destroyed. The retort of the board is that the data were at the head office of the company and that it had been seen by people who negotiated the option. The whole point after all is whether boring is an adequate test. The case of the Pioneer mine in Tasmania is cited as an instance in the affirmative. There, however, the bores were put down in squares and were a chain apart. Nothing like the same close boring was done on the Tongkah. The area of the claim is about 6 square miles and the three experts who did the examination had about a month in which to carry out their work. It is not at all clear that they were able to devote all their time to boring. Even if they sank 60 bores, many of these admittedly must have been fully 1000 ft. apart. However, the allegation that the engineers did not personally direct operations may be dismissed as absurd. But the point now under discussion is not at all the merits or demerits of the property; it is the method of investigation. We in Australia have come to regard bores put down on dry land as merely evidence that there is tin or gold in the ground, but not a safe guide in making estimates of profit.

Eastern Australia.

Charters Towers.—Walter E. Cameron, assistant geologist to the Queensland Government, has been inspecting the Charters Towers district. He points out that the ground underlying the mapped outcrops of felsitic dikes has been markedly unfavourable to the deposition of gold. "If this conclusion be correct it is

interesting as a fresh example of the influence of country rock on the gold values of veins occurring in it." He devoted a great deal of attention to the Day Dawn reef and he does not hesitate to hold out the hope that there is plenty of room ahead for prospecting work with a reasonable chance of success. He says that "the most hopeful prospect of continued productiveness seems to lie in the development of the eastern ground on the Day Dawn fissure, and the activity of the mines at this end of the field in sinking their shafts to develop this ground will demonstrate within a very short time whether this prospect is likely to be realized or not. In this connection, it has been pointed out that an amalgamation of interests would in many cases be an advantage, as it would spread the burden of expensive exploration over a greater number of shareholders, and would allow of the more economical mining of the ground if anything should be found. The smaller areas, which were perhaps suitable for the more flatly dipping and richer reefs, now practically exhausted, are quite unsuitable where expensive prospecting has to be undertaken before payable bodies of stone can be expected to be developed. The western ground also affords prospects which, however unpromising at present, may at any time brighten sufficiently to allow of a more energetic development of this end of the field. On the Brilliant line of reef the recent find of good stone at a depth of over 2000 ft. in the Brilliant Deep Levels mine, and nearly 1000 ft. from the nearest payable stone on that reef, may lead to a very considerable addition of production."

Copper.—The news from the Hampden and Duchess mines in northern Queensland is satisfactory, as better grade material has been found at the bottom level of both mines. The development at the Duchess is of the most importance as the company has got 10% ore in the face at 230 ft. north and 12% in the crosscut driven to the west to test the orebody on that side. The Great Fitzroy, on the other hand, remains a market problem. Shares have fallen in value, but no explanation is afforded as to what is driving them downhill. Some of the selling has been done by people who know their business very well when it comes to handling scrip.

Gold Output.—The return of gold of Victoria for April amounted to under 40,000 oz. This is the smallest output recorded for the month in many years in the State and it has occasioned a good deal of comment. The fact of the matter is that the gold-mining industry, not only in Victoria, but in almost the whole of the Commonwealth, is in an exceedingly depressed state. That is shown by the following table giving the returns (in ounces) for the first four months of the last three years.

	1908	1909	1910
Victoria	198,499	206,033	189,278
New South Wales	77,301	66,486	63,456
Queensland	133,408	127,411	139,893
Western Australia	556,353	520,159	481,110
South Australia	2,600	1,400	2,480
Tasmania	20,000	20,000	14,800
Total Commonwealth	988,161	941,489	891,017
New Zealand	150,077	135,843	142,070
Total	1,138,238	1,077,332	1,033,087

The decline in Victoria is due to the collapse of 'deep lead' mining. This has fallen to relatively small dimensions and unless the Cathcart mine at Ararat keeps public interest sustained it is unlikely that there will be any expansion unless some new channel is found under the basalt. In New South Wales the returns are helped by the dredges. Queensland figures have been favourably affected by the Mount Morgan yield. In West Australia the poorer ore mined at depth is telling its own tale. It is certain that the outlook for the current year is for a decreased production, but it must not be assumed that operations are being restricted. More attention will be devoted to the treatment of low-grade ores and the prospector will have to go into the back country to try his luck there. Official statistics are notoriously slow but it is none the less of interest to learn that in 1908 the output of minerals for the Commonwealth was £24,568,064. Since records have been kept the mineral wealth won from the soil has totalled £714,903,750. The output of gold has been £501,474,770, an amount so large that the public do not understand the falling off now evident nor do they appreciate the reduction.

The Mt. Lyell Mining & Railway Co. has presented its half-yearly report. This is one of the best managed companies in the southern hemisphere, if not anywhere. Everything is run on Australian lines and these represent absolutely the best mining and business practice. Of course, it may be said that Robert Sticht and A. L. Dean are Americans. [Undoubtedly.—Editor.] Mr. Sticht has so perfected his organization that the whole concern works like a piece of clockwork with Australian hands in control in nearly every department. The business side of the establishment, however, is purely Australian and it is not too

much of a crow to say that for honesty of purpose, absence of share-trafficking, and general capacity in management there is no board of directors more respected, except perhaps those of the Broken Hill Proprietary Co. Members of the one board belong to the other and so it is to be expected that the conduct of one of these great mining concerns should resemble that of the other. Shareholders in either company get the best possible treatment.

The most interesting feature about the late career of the Mt. Lyell is the development of the business side of its enterprise. Hitherto the bulk of the supplies of pyritic ore for use in the manufacture of superphosphates has been drawn from the Mt. Lyell mine. But now that mining instead of open-cut work has to be done there, the management has cast about for other sources of supply and has obtained a deposit of iron pyrite near Zeehan. This deposit was got for a mere song. There was no first vendor, no second syndicate, and no small vending company to the big concern. The original owner was met by the board, the bargain was struck, the money paid, and the property taken over for the company. The quality of the pyrite is exceptionally good and as an adjunct to the company's works the deposit is of great value. A superphosphate works is being erected in West Australia to meet the growing requirements of the agricultural industry there. This will cost £80,000, but no fresh capital is demanded. The company's reserve has been drawn upon, but once the outlay is completed the board will soon set to work to build up that side of its finances. On March 31 the surplus of liquid assets, at a conservative valuation, was £450,000 above the liabilities. The profit for the half-year was £115,335, after liberal writing down.

Sorting Ore in Mexico.

MEXICO.

Panuco.—The annual report of the Compañia Minera de Panuco, a strong concern in the State of Sinaloa, shows a total revenue in 1909 of 884,182 pesos, and profits of 476,838 pesos. Out of these profits dividends of 425,000 pesos were paid, bringing the total disbursement to stockholders during the 33 years of the company's existence up to 7,465,000 pesos. In 1909 the company produced only 13,411 tons of ore, but this contained a total of 15,324 kilo. silver and 102 kilo. gold. A total of 68 tons of rich ore was shipped to the United States. The mines are equipped with 40 stamps, concentrators, and cyanide annex, all the machinery being moved by direct water-power. This results in more economical operation than is usual in Sinaloa, the cost of treatment per ton of ore in 1909 being 8·31 pesos. The company is controlled by Spanish business men of Mazatlan. There has been recently some correspondence with Los Angeles parties in reference to the sale of the properties, and a price of 6,000,000 pesos has been asked, but nothing definite has been done.

Guadalupe de los Reyes.—These widely known Sinaloa mines had a production in 1909 of 1,427,000 pesos. Operating expenses were heavy, and dividends of only 290,000 pesos were paid. The company has exhausted adjacent timber supplies, and will have to solve the power problem in order to operate economically. The installation of gas engines at a point where charcoal can be readily obtained is now under consideration, the plan being to generate and transmit current to the mines and reduction plant. The Compañia Minera Guadalupe de los Reyes has paid as much as 1,500,000 pesos in annual dividends, but for several years its disbursements have been on a smaller scale. The mines have a record of immense production.

San Antonio Placers. These old placers, in the Barranca district of Sonora, which yielded millions in colonial days, have been taken up by New York interests, represented by Herman Hendler, and are being prospected with Keystone drills. So far the results have been entirely satisfactory. The prospecting will be continued for about three months, and if at the end of that time the showing warrants it, dredging machinery for working the placers on an extensive scale will be installed. The Spaniards worked the gold-bearing gravel down the gulches from the mountains until stopped by water. The town of San Antonio, established early in the 18th century, is on gold-bearing ground, and a new town is to be built for the inhabitants. The old town will be demolished. The bells in the San Antonio church bear the date of 1742. The Yaqui Mines, Ltd., an English concern identified with the Hudson's Consolidated, is developing a gold property above the San Antonio placers, known as the Veta Grande. A 12-ft. lode has been cut, the ore running $13 per ton in free gold. Mr. Wendler is also in charge of operations for the English company.

Boleo.—The Boleo Copper Co., controlled by the Rothschilds of Paris and operating at Santa Rosalia, in Lower California, is planning several important changes. At present the percentage of copper lost in the slag is high, and a shipment of pyrite is to be brought from Spain with a view to making experiments in mixing it with Boleo ore. A result of these experiments may be the operation of the Inguaran copper mines in Michoacan, where big supplies of pyrite are available. The Inguaran mines are controlled by the same interests, and have been extensively developed, but they are without transportation facilities and the construction of a railroad to the Pacific coast would be necessary to make possible the shipment of ore to Santa Rosalia. The Boleo is now shipping matte running about 63%, and it is planned to lower the grade, install converters, and ship the product as blister copper. The production of copper now averages about 1000 tons monthly. The company last year completed 8 new water-jacket furnaces of 200 tons capacity each, making a total of 18 erected since operations were commenced. The first plant consisted of 4 furnaces of 120 tons each; the second, 6 of 150 tons. The company is working three groups of mines, the Purgatoria, Soledad, and Providencia, and operating 40 kilometres of narrow-gauge railroad. It gives employment to 3500 persons, and supports a population of about 8000. A protected harbour with a protected surface area of 37 acres was made at Santa Rosalia a few years ago by the construction of breakwaters with solidified blocks of slag. The Boleo Copper Co. was organized in 1885 with a capital of 12,000,000 francs, originally divided into 24,000 shares of 500 francs each. Some time ago each of the 500 francs shares was divided into 5 shares of 100 francs each, making a total of 120,000 shares. The profits of the company since 1900 are stated to have averaged over 1,000,000 francs yearly. The company secured 20,000 hectares (49,400 acres) under the concession granted by the Mexican Government, and increased its holding by the purchase of 11,920 (29,442 acres).

Hostotipaquillo.—This part of the State of Jalisco, which received attention during colonial days, and was the scene of important Mexican operations in later years, now promises to become an important district. A transmission line is being completed by the Chapala Hydro-Electric & Irrigation Co., of Guadalajara, and electric power for mining is promised before the end of the year. The Cinco Minas, well known *antiguas*, were purchased by the Marcus Daly estate, of New York, a few months ago for 570,000 pesos. Gratifying results are attending new development work, and a 250-ton reduction plant is proposed. The Virginia & Mexico Mine & Smelter Co., of Richmond, Va., is operating a 150-ton plant, using steam-power. El Favor Mining Co., of New York, has a 100-ton plant completed awaiting the advent of electric power. Machinery for transforming the old Amajac reduction works into a modern plant has been ordered by the Amajac Mines Co., of New York, and custom milling will be done. The company owns adjacent mines. A 225-ton plant has been ordered by the Consolidated Mining Co., of New York, for the Casados mines, and the first 75-ton unit will be completed by December. The Mina Grande, an *antigua*, has been taken over by a company in which F. J. Fournier, of Paris, the Dos Estrellas millionaire, is a stockholder. All the Hostotipaquillo plants are for treatment by concentration and cyanidation.

Pachuca.—The rapid growth of the mining activities of this district are such that in the near future the local electric power company, the Cia. Electrica e Iggigadora de Pachuca, will not be able to supply the demand. Their maximum supply, as defined by their hydraulic plant, is 12,000 horse-power. To furnish the extra power needed the Mexican Light & Power Co. is building a branch to the main transmission lines from Necaxa.

New railway.—One of the most important new enterprises projected in northern Mexico is the building of a railroad from Tucson, Arizona to Altar in Sonora, thence by way of Caborca to Puerto Lobos on the Gulf of California. The concession was originally obtained from the Mexican Government by the brothers Sandoval of Nogales and has been taken up by Frank Murphy of Tucson on behalf of the American Development Co. of New York. It has been said that the El Paso Southwestern railway was backing it, but officials of that road deny the statement. Another rumour affirms that it will become part of the Rock Island railroad system, giving them an outlet to Pacific tidewater in connection with the El Paso Southwestern, which latter will soon be completed to Tucson. This seems credible. The primary basis for the new road lies in the large mineral belt that it will open to the world. The Altar gold placers have recently sprung into prominence. They are of considerable extent, and many of them yield unusually large quantities of gold per cubic yard. Two classes of gravel exist, one being cemented, requiring mechanical disintegration; the other being loose and adapted to dredging. Water, however, is scarce, but companies possessing sufficient means can develop water in amounts adequate for dredging. A great rush of prospectors and speculators to Altar has occurred within the last two months. Caborca is the centre of a promising gold-quartz district, where a few mines have already made a creditable record. Farther west, toward Puerto Lobos, large veins of gold-bearing copper ore are said to exist; but prospecting has been retarded by the inaccessibility of the region. On May 5 Tucson celebrated the opening of a new railroad by way of Twin Peaks to Nogales. This makes a short cut to the northern terminus of the Southern Pacific of Mexico railroad, which is now constructed down the west coast beyond Mazatlan to Tepic. There is also talk of an immediate extension of the railroad southward from Nacozari, Sonora, to Moctezuma, which has developed mines of promise.

LIMA.

Ferrobamba.—If the statements covering the report on the Ferrobamba copper property, situated about 70 miles southwest of Cuzco in the department of Apurimac, are realized Peru is to become important in mining once more, as in the days of the Spanish regime, but now as a producer of the red instead of the white metal. A party of engineers is engaged in development work which is expected to prove the existence of 400 millions of 8% copper ore carrying a small gold and silver content. About £20,000 will be spent in this work. The mineralization is said to occur in quartz-porphyry, intruded below limestone, and has an average width of 1000 metres; the outcrops can be traced for 7 miles. Water-power is abundant and may exceed 100,000 horse-power, so that a railroad, necessary for cheap transportation and handling of material, could be operated by electricity and thus eliminate the question of fuel for locomotives, which is usually a serious matter on railroads in Peru. Fuel for smelting would probably have to be imported, for no coal seams have been discovered in the vicinity. It is believed that the ore can be charged direct to the furnaces, thus effecting low operating costs. Investigations have also been made in London with a view of ascertaining whether the ore can be profitably smelted in the electric furnace. A railroad survey will be made by the Peruvian

REAL DEL MONTE, NEAR PACHUCA, MEXICO.

Corporation, starting from Cuzco, the present terminus of the Southern railroad of Peru, about 817 kilometres from Mollendo, the second largest port in Peru. It may be possible to construct a line to the coast, about 250 miles long, which would encourage the development of a part of the country where little has been done as regards mining. English capital is behind the project.

Sayapullo.—The 'Compania Minera de Sayapullo' is opening up copper-silver veins at Sayapullo, about 150 kilometres to the northeast of Trujillo, in the department of Cajamarca. The property was reported upon, several months ago, partly for the account of New York people and partly for the local company. The ores occur in veins traversing slate, sandstone, and limestone, or in the stratifications of the same, and vary from 6 to 70% copper with variable amounts of silver and small gold contents; some bismuth is also found. The vein varies from 0·5 to 2·0 metres wide, and the outcrops are stated to be traceable for 4 to 5 kilometres. Small monthly shipments have been made varying from 38 to 49% copper but no extensive work is carried on. The rich ores are said to be the result of secondary enrichment; in depth primary sulphides have been found averaging about 5% copper. The property is favourably located as regards water and coal, large deposits of the latter having been discovered 10 kilometres away. Regarding transportation, the best route at present to the railroad which connects with Salaveery, the seaport used at present, is 90 kilometres long. It appears feasible to build a line direct to the coast where there is a good harbour, a distance of possibly 100 kilometres. This would serve to open up the coalfield as well as affording cheaper transportation facilities to the copper property. It is rumoured that the affairs of the company are not well managed.

Cerro de Pasco.—The new general manager, A. B. W. Hodges, and smelter superintendent, C. F. Shelby, of the Cerro de Pasco Co. have arrived, succeeding R. H. Channing and S. J. Gormly, both of whom resigned. The latter two effected successful improvements throughout their administration and turned a doubtful proposition into a profitable business. During the first ten days of May, 30,000 copper cakes were shipped to New York, by way of Panama; this is equivalent to 6,600,000 lb. copper. A large stock of metal had accumulated owing to numerous landslides, which tied up traffic, intermittently, for almost two months, on the Central Railroad of Peru.

SAN FRANCISCO.

Petroleum continues to attract much attention in California. Dividends to the amount of $1,326,626 were declared in May by oil companies listed on the San Francisco Stock Exchange, making the total to date, $31,284,903. There have been, in addition, considerable disbursements by unlisted companies and large sums have been realized by sale of properties. It is estimated that the total now directly invested in productive oil properties amounts to $210,000,000 and that, with an output of 79,000,000 bbl. this year as is estimated, and an average price at the well of 40c., the gross return will be $31,600,000 of which at least one half will be available for dividends or surplus. The great growth of the oil industry in the State has resulted from the large and unsatisfied demand for fuel throughout the Southwest and the nearness of the fields to tidewater, which effectually prevented monopoly of transportation. There are, for example, five pipe-lines in addition to railway transportation, now leading out from the Coalinga field. Two, belonging to the Standard Oil Co., extend to Richmond, on San Francisco bay. One, the property of the Associated Transportation Co., leads to Monterey bay; another, that of the Associated Pipe Line Co., extends to Port Costa on San Francisco bay; and the fifth, belonging to the Producers' Transportation Co., connects the Coalinga, McKittrick, and Midway districts with Port Harford. The Southern Pacific and Santo Fe railroad companies are said to be planning to build immediately a line over Tehachapi pass to supply their locomotives and plants, while an ambitious project for a great system of pipe-lines eastward through the mining districts of Arizona as far as Douglas and south into Sonora, is under serious consideration and the lines in all probability will be built shortly. There are three great interests in the local oil industry: the Standard Oil; the Associated, a Southern Pacific enterprise; and the Independent Producers' Agency, which works in close harmony with the Union Oil Co. So perfect are the systems of transportation now in vogue that it is said oil can be shipped profitably to any foreign market and can be laid down in New York harbour in competition with Pennsylvania anthracite. The pipe-line charge made by the 'Agency' is 22½c. per bbl. to tide-water at Port Harford or 2½c. for delivery to railway lines. Representative contract-rates on oil from Port Harford are as follows: to San Francisco, 10; to San Pedro, 10; San Diego, 12½; Eureka, 20 cents per bbl. Production for April was 6,622,061 bbl.

POOL OF OIL FORMED BY THE LAKE VIEW GUSHER.

THE LAKE VIEW GUSHER AT THE END OF MAY.

and but a small part of the probable oil territory is yet in production.

The greatest oil-well in California, and probably the greatest in the world, is the Lake View, in the Midway field, shown in the accompanying photographs. This well, belonging to the Lake View Oil Co., of which the Union Oil Co. owns control, was brought-in on March 15 at a depth of 2265 ft. Its first day's production was estimated at 47,000 bbl., and it is thought to have obtained a maximum of 90,000 bbl. on several days since. It is now, in June, flowing a stream of oil that amounts to at least 25,000 bbl. per day and resembles the stream in an irrigating ditch. The oil has been mainly caught in open ponds or reservoirs and while there has, inevitably, been much wasted, that saved has already amounted to over 3,000,000 barrels.

Geological factors.—The outlook for mining at Bisbee is encouraging. Some geologists point to the circumscribed area of the Carboniferous limestone of the district as indicating the boundary of the ore-zone, and the greater portion of this has been fairly well explored. On the other hand the possibilities in depth are important. Limestones exist through the Devonian and Cambrian, and there is no reason why the porphyry may not have mineralized these as well as the upper limestone of the Carboniferous. It is now proved that primary sulphide deposits are present, those on the lower levels of the Junction mine of the Superior & Pittsburg being a case in point. These have clearly been deposited by replacement out of solution above the critical temperature of water. As is well known, the orebodies at Bisbee have been soft, so that it has not proved profitable nor feasible to develop them in the usual way in order to block and value large tonnages. Hence a good deal of reasoning from similarity of conditions is relied upon in judging the available reserves. Geological study is aiding greatly in the exploration and discovery of new orebodies, although it offers no sure basis for predicting their size. Both the Copper Queen and the Calumet & Arizona now maintain well organized geological corps, and in a year or two the accumulated information may lead to establishing better indices to the possibilities in depth. At present there would seem to be no reason why the future production of the district should not equal or exceed its past.

At Cananea, Mexico, only a short distance from Bisbee, Arizona, great things are being done by L. D. Ricketts. His management is characterized by the most minute investigation of every detail, and by persistent improvement of method and reduction of cost. With the enormous tonnage of ore already developed, amounting to many millions, with tens of millions indicated, and with such able management, great results may be anticipated. The famous reverberatory smelter, using oil as fuel, is now reducing copper ore and flue-dust to 38% matte for not over $1·70 per ton. A second reverberatory furnace is being built alongside the first. This conforms closely to the lines of the former, only a little elevation and thickening of the arch being made at the point where greatest corrosion occurred, which is about 30 ft. from the fire-bridge. Mr. Ricketts is erecting an apparatus for economically mixing flue-dust with converter-slag, which produces a scoriaceous product that works well in the blast-furnace. As produced it comes out in great balls, sufficiently porous to admit of good penetration by the blast and gases in the furnace. It is a superior product to that made with copper flue-dust by sintering. This plan of flue-dust disposal had been in use by the Copper Queen for some years. Owing to inadequate arrangements for handling it, and the amount of crane-time taken in pouring ladles, the practice was discontinued.

The Alaska season has opened and outgoing steamers are crowded. The *Corwin* maintained its record of being the first steamer at Nome by landing passengers and freight on the ice three miles out, on June 1. Dredging will be particularly active at Nome this year. It is expected that eight new dredges will be put at work and several have been shipped already. At Fairbanks the winter's work has prepared a large amount of gravel for the spring clean-up and prospecting quartz claims has made good progress. It is characteristic of the spirit of the Far North that a small stamp-mill being needed at Fairbanks for testing quartz ore, one was promptly built by the local foundry despite the fact that no drawings were available and the only picture at hand was an advertising half-tone. The mill none the less has done good work and the mining industry of the future will owe it a heavy debt in that it permitted tests to be made and plans to be formulated during the winter.

Iditarod and the Innoko country are attracting wide attention, and the biggest rush since the Klondike excitement is now under way. At Chena, Fairbanks, and other points up the Yukon, boats of all kinds and descriptions were loaded and waiting at the break-up of the ice. So great was the rush that mining operations at Fairbanks suffered from labour shortage. Miners from the river towns, rein-

forced by others who came in by way of White Pass, were first to reach the ground this spring. Steamer accommodations from Puget Sound ports have been sold in advance for some time. A direct route by way of Bethel and the mouth of the Kuskokwim is being also operated. Steamers have started on this route from Seattle and others are to follow from San Francisco. There are the usual stories of rich gravels extending "fifteen miles along the creek and 600 ft. wide," but the tests made last fall and word brought back to Fairbanks during the winter are not enough to warrant final conclusions as to the value of the discovery. Near the Innoko and Iditarod there is a large area of nearly unknown and unprospected territory and it would be quite on the cards that a rich placer district should be developed there.

Prospectors in Alaska.

Alaska has been much in the lime-light at Washington this winter in connection with coal-land legislation, railway construction, and proposed changes in mining laws. An investigation is now being made by the Senate Judiciary Committee and there are rumours of serious charges against the Guggenheims and their agents in connection with their reported attempts to monopolize the country. There has been so much misinformation that it is hoped the investigation will be sufficiently thorough to set the matter at rest. Sentiment among engineers, at least, is to the effect that in the coal cases both the Guggenheims and the Cunningham claimants have been much maligned. It seems probable that the much discussed claims were, after all, taken up in strict compliance with the law, and that they will be eventually allowed. The amount of coal land involved, some 5000 acres, is none too large as a basis for the railway-building under way. The Copper River railway, by the way, made good progress during the winter. While the ice went out before the bridges were completed, the work was so well protected that little damage resulted. From the end of the line, by means of river steamboats, connection is maintained with Chitina, and shipments of copper ore can begin this year.

JOHANNESBURG.

Square Fathom Controversy. — The paper by W. W. Mein on 'Rand Mine Returns, with special reference to the new Fathomage System' was read before the South African Association of Engineers on June 15. So much had been said about the paper, in the Press and out of it, and such high expectations had been aroused as to its weight and importance, that many must have been disappointed. The paper bears marked evidence of having been hastily compiled and of being pieced together without great attention to the proportional significance of its parts. As a verbal counterblast to the oratory of H. F. Marriott it appears thin indeed. It must be recognized, however, that Mr. Mein approaches his subject from the coolly scientific standpoint of the mining engineer, and not as a rhetorician with an eye to the picturesque. Evidently the aim was decisively and permanently to dispel the flickering delusion that the Marriott scheme of basing mine returns on the unit of 'square fathom' mined is technically sound and at the same time to explain the tonnage methods by which, in Mr. Mein's opinion, the significance of results can be most intelligently judged and the change in underground efficiency most quickly recognized. The informative part of the paper gave some highly instructive data relating to the established systems of certain Eckstein mines, where the systematization of returns is carried to the height of practical excellence without taint of statistical mania. It is interesting to learn that stoping costs and efficiencies have all along been considered chiefly on the 'square fathom' basis. In other words, the unit is employed where it can be pertinently applied and disregarded when it becomes inappropriate. Regarding the use of the 'ton milled' as a unit, Mr. Mein points out: "A unit of cubic measure, cubic yard, cubic metre or 'load' [he might have added 'cubic fathom'] could be used without affecting the fundamental principle, for it is through dimensions that we arrive at the accepted unit, but the simplicity of the short ton is appreciated upon the Rand as upon the majority of metalliferous mining fields. . . . . Rand controls have suc-

ceeded in reducing costs per unit of work, expressed in the foot development, fathom stoped, ton mined, shovelled or trammed, or any pertinent manner, according to the class of operation considered; the final results being expressed on the basis of ton milled or unit of equipment capacity."

Destructive Criticism.—As the 'square fathom' system of mine returns is unlikely to prove more than a passing symptom, and will be of small permanent concern on the Rand (and certainly of no import outside of it), there is no need to labour the points established by Mr. Mein at great length. Attention is directed to the danger of striving for "maximum profit per fathom," which, under the proposed scheme, was to be made the criterion of good management. A "high return per fathom might be obtained for a period by selection of a character that is dearly paid for in course of time." One of the most striking arguments in the paper is that advanced to remove the popular impression that because a certain manager may make a bigger profit per square fathom, he is necessarily doing better than his predecessor because the area of the property is fixed. "It is true," says Mr. Mein, "that a property of 1000 claims contains 1,778,500 square fathoms on the horizontal or 2,050,000 on the incline at a dip of say, 30 degrees, but it is not in relation to one of these fathoms that results are shown. . . . The fathom employed is given as the fathom 'stoped' on all 'reefs' . . . . on a mine with two or three reefs, each with varying degrees of payability, the total fathomage providing our units may range from 2,000,000 to 6,000,000 fathoms, according to the percentages of each reef mined and the scheme of working. This circumstance suggests why we should not attach such extravagant importance to profit per fathom or any other unit but should give greater weight to total profits and the maximum present worth of the whole property."

All the different points in the fathomage scheme are discussed in detail, and in the opinion of Rand engineers, all the serious defects, which are beyond mere 'modification,' disclosed that will prevent its elevation to a place of practical utility. The proposal may at least gain credit for having had stimulating effects and for having provided no little amusement to students of mining economy.

Stope-Drill Contest.—The stope-drill competition, arranged by the Government and Chamber of Mines two years ago and commenced in May 1909, was recently completed and the prizes, amounting to £5600, were awarded to the winning manufacturers and miners on May 28. Only an interim report has as yet been issued and those who are aware of the vast amount of minute data collected during the long run will be well content to wait for the final conclusions of the committee. The Chamber of Mines nevertheless issued a statement, at the prize giving, containing many noteworthy facts and opinions. It was originally hoped to complete the trials within six months, but "difficulties in connection with the securing of a satisfactory pressure of compressed air prolonged the tests to nearly twelve months." As a minimum of only 60 lb. pressure was demanded this point may strike foreign engineers as worthy of explanation. Since no abnormal pressures were called for, the difficulty seems to add force to the criticism (frequently heard from the contractor) that air compression and transmission are often loosely managed. The root of the trouble is generally the great variation in the demand, fluctuating with the supply of hand labour. The erection of central compressor stations will overcome a trouble of old standing. Some of the broad lessons of the test may be noted by condensed extracts from the Chamber of Mines statement. The hammer type of machine has not come to the fore, in spite of the promise of good results given by the now condemned Gordon drill in 1907. According to the rules of the competition, the maximum weight of machines was 100 lb. This was found to be needlessly small, for since natives are required to help the miner in rigging up, there is no reason why this weight should not be exceeded and a machine of about 130 lb. adopted, of greater durability and thus less costly to maintain. The footages drilled by the four leading machines, allowed to count for the purposes of the competition, and the cost of drilling per foot, including white and native labour, drills and drill-sharpening, spares, stores, and depreciation, were as under:

Name of Drill	Holes Drilled Feet	Cost per Foot Pence
*Holman 2½ in.	12,779	9·77
*Siskol	14,083	9·90
Holman 2⅜ in.	11,744	10·91
Chersen	11,781	11·94

*Joint Prize-winners.

The competition took place in stopes varying in width from 24 to 45 inches. The cost of spares and stores, and the charges for depreciation (included above) differed as follows:

	Spares	Stores	Depreciation
Holman 2½ in.	£24. 11s.	£22. 17s. 11d.	£60. 18s. 9d.
Siskol	£74. 10s.	30. 5s. 0d.	58. 6s. 3d.
Holman 2¾ in.	£46. 7s.	24. 10s. 10d.	50. 18s. 9d.
Chersen	£124. 11s.	24. 3s. 3d.	42. 11s. 3d.

The Siskol made a bigger footage than the Holman 2½, but cost much more for spares. The competition cost £17,500 (including the prizes) and, as the Chamber states, "nothing very wonderful has been shown by the work done." There is, of course, lack of all finality. If the contest was started again, under similar conditions (allowing a wider range in matter of weight), it is certain that different results would be obtained. Good lessons have been learnt by the manufacturers of the drills and improvements suggested that could not be introduced during the trial. For instance, it is said that the Siskol, as put upon the market today, is heavier than the competition machine

On the way to Porcupine.

and embodies improvements. So with the Holman and other makes. The principal benefit of the trial has been in educating the manufacturers and in providing them with opportunities for introducing new designs that might have received meagre attention under ordinary conditions in the face of personal prejudice.

Bantjes.—Because the grade of the Aurora West and the Vogelstruis Deep had not been coming up to expectations as to the prospects of this near western district, some opinions were recently expressed in these columns to the effect that the story of the Bantjes will be more satisfactory than that of its neighbours, when production is commenced in the near future. In July the Bantjes will start crushing with its plant of 20,000 tons monthly capacity. At the special general meeting held on June 9, for the provision of more working capital, the chairman (A. E. Wallers) added some significant information to that given previously. The vigorous development policy advised by the consulting engineer in 1909 has been carried on with results clearly justifying the boldness of this side of the company's policy; upwards of 3000 ft. of advance have been made per month — a footage that very few mines exceed. About 800,000 'payable' mine tons are now developed, nearly all on South Reef. Promising results have also been obtained on the Main Reef, by cross-cutting on the sixth level, from No. 1 shaft. If any considerable zone of Main Reef of fair grade can be opened up, it will be a particularly useful auxiliary to the narrow South Reef in times of ore shortage.

Quartz outcrop in swampy ground.

TORONTO.

Porcupine is undergoing steady development under difficulties, the transportation of heavy supplies and machinery being impossible except during the winter. There is an influx of prospectors and mining men, but not the rush that was anticipated, for it is being realized that the district is essentially a low-grade proposition requiring extensive development and costly machinery before returns can be expected. Intending investors find the demands of many claim-owners so exorbitant under the circumstances, that there is an indisposition to close transactions until more moderate views prevail. The Timmins brothers are putting up a trial plant of 15 tons capacity to treat ore extracted in development, by amalgamation and cyaniding. The Hollinger plant is in active operation and employs a force of 90 men. Assays of $347 per ton have been obtained from ore taken from the cross-cut of No. 2 shaft at the 60 ft. level. Three claims situated in the southern section

of Shaw Township, on which free gold has been found were recently sold for $20,000. During the early part of June the camp was visited by Willet G. Miller, the Provincial geologist, whose official report will shortly be issued.

Gowganda, like Porcupine, is handicapped by the cost of transportation, which makes it unprofitable to ship 400 oz. silver ore, so that only high-grade is being sent out. The Big Six, Milleret, and Bonsall are getting out richer ore at depth and a number of companies are accumulating concentrating ore on the dump. The Morrison claim, which has a strong native silver showing, is under option to an English syndicate.

Cobalt is making a good shipping record this season. A comparison of the output for the first five months of the year with that of the corresponding period of 1909, shows total shipments of ore and concentrate for the current year amounting to 11,995 tons, as against 12,064. This, through a slight falling off in tonnage, is accompanied by a considerable increase in value, owing to the larger proportion of concentrate shipped. There are this season 13 concentrators in operation, as compared with 6 a year ago. Important additions are likely to be made shortly. The Crown Reserve and the Hudson Bay are to erect concentrators, and other companies are seeking to arrange contracts for the treatment of their low-grade ores at the Northern Customs smelter. The heaviest shipper during the five months was the La Rose, with consignments amounting to 2652 tons, the Nipissing coming next with 2216, the third on the list being Kerr Lake, 1715 tons, or four times the output in the corresponding months of 1909. In addition to ore shipments, bullion to the value of $58,225 was shipped from the O'Brien and Buffalo plants. The Nipissing has made an important find on a portion of its property hitherto considered poor ground; this is in the Keewatin formation, which has been regarded as seldom likely to prove productive except in close proximity to the diabase. The Nipissing management has decided to remove the soil covering the rock on their entire property. Turbine pumps are to be installed on the lake and the earth will be washed off. This plan was adopted because it was found that trenching did not suffice to disclose all the veins, many having been picked up after the ground was supposed to have been thoroughly prospected by trenches. The Crown Reserve found a new vein last month, 2 to 6 in. wide reported to assay 4000 oz., on the 100 ft. level. It will be known as the Victoria vein. The Hudson Bay ore reserves have been increased by the finding of a new high-grade vein in a cross-cut southeast of the drift on No. 6 vein. It carries smaltite and native silver; the wall-rock for 6 ft. bears leaf silver and will make good milling ore. Conditions at the La Rose are improving. Trenching on the Fisher-Eplett property has disclosed a number of quartz veins and calcite stringers, besides one vein carrying low-grade silver ore, which has been uncovered for 250 ft. The main shaft is being put down to 500 ft., where a station will be cut, making this the deepest mine in the district.

Some increased dividends have been declared. The Buffalo will pay an extra dividend of 3%, in addition to the regular quarterly 5% dividend. The Nipissing gives its regular 5% dividend, a 2½% bonus for the quarter and an extra 5% bonus. The McKinley-Darragh has declared 3% and for the first time supplements this with a 2% bonus. The effect on the stock market has been inappreciable, for the general public have completely lost interest in Cobalt stocks.

Coal or lignite discoveries along the Metagami river seem likely to become an important factor in the development of that district. The latest reports are to the effect that cannel coal of good quality has been discovered beneath the overlying deposits of lignite. Many additional locations have been taken up. The Provincial Department of Mines will make a thorough investigation. Willet G. Miller, the provincial geologist, is now on his way to the district.

Explosives.—Owing to the alarming frequency of mining accidents due to the use of explosives, to which attention has been drawn by the recent controversy in connection with the Canadian Mining Institute meeting, the Canadian Minister of Mines is preparing legislation to be submitted at the next session of Parliament. It is proposed to organize an Explosives Division of the Mining Department and establish a station for testing explosives. All explosives used in Canada are to be subject to examination and test. At present in the absence of any such provision mine managers and others have no means of determining what explosives are safe, or whether imported explosives are of the standard demanded in the country of their manufacture. Government inspectors, with wide powers of search and inquiry, will be appointed to enforce the regulations. In framing the details of the measure the Minister proposes to secure the assistance of one of the British Government experts from

the explosives testing station at Woolwich, to investigate the conditions under which explosives are made and stored in Canada, and make recommendations as to regulations.

CAMBORNE.

Arsenic. — The fume question has been troubling more than one mine recently. The farmers and inhabitants of the Bissoe valley complained of the arsenical and sulphurous fume from Wheal Jane mine belonging to the Falmouth Consolidated. The Redruth urban council took the matter up and a deputation visited the works. The explanations of the engineers appear to have been satisfactory, for no action has so far been taken. South Crofty is also alleged to be doing damage to the farmers by the fume from the arsenic refinery and an action for damages is set down for hearing on the 26th. The result of this lawsuit is eagerly awaited and it will be interesting to compare public opinion as reflected by the legal judgment with that prevalent in earlier times. In the meantime the company is building an extra 400 ft. of settling flue and another chimney 95 ft. high.

South Crofty. — This mine continues to exhibit up-to-date methods and the cost is being reduced to a figure hitherto unknown in Cornwall. During the first half of this year the cost has been just 20s. per ton of ore treated. This cost includes development, shaft-sinking, equipment, and London expenditure, but presumably excludes income tax and lord's dues. During this time the development work and shaft-sinking has covered 2200 ft. The Robinson shaft is now down 1375 ft., and as two rock-drills have recently put on the work the rate of sinking will be increased. Cross-cuts from the shaft have been driven at the 960 ft. and 1020 ft. levels and have found the lode. A winze is being sunk from the 960 ft. and a rise cut from the 1020 ft. The lode here is from 12 to 15 ft. wide and contains 38 lb. of black tin and wolfram to the ton, the proportion being roughly 4 of the former to 1 of the latter. The output for the half-year was 30,240 long tons of ore yielding 307 tons of tin concentrate, 61 tons of wolfram concentrate, and 327 tons of arsenious acid. The yield has been rather less than before but the increased price obtained has compensated. This increase in price has not been due solely to the price of the metals but also to the greater efficiency in separating them during dressing.

Alluvial Mining at Breney Moor. — An 'Alpha' dredge has been erected at Breney Moor, Lanlivet, near Bodmin, by J. W. H. Dew, engineer for Alluvials Limited, a London company. This machine is not strictly a dredge. The gravel is hydraulicked by means of a monitor and delivered to a sump, from which it is pumped to a sluice-box at the top of the dredge. The sluice-box is 130 ft. long and 7 ft. wide, and the capacity is 3000 cu. yd. per week. The total cost of treatment is estimated at 4½d. per cu. yd. and it is claimed that gravel containing one pound of black tin per ton is profitable. The dredge is not often moved. It is noteworthy that the power is generated by a gas engine and gas producer, and the monitor operated by a pump, not by a natural head of water.

Inspector of Mines.—Much dissatisfaction has been expressed locally that, in the recent re-arrangement of districts, Cornwall and Devon were not made into a separate inspectorship. It has long been a grievance that metalliferous mining in these counties has been jumbled together with the coal-mining in Monmouth and Gloucester. The retiring inspector, J. S. Martin, of course, was as well known in Cornwall as in other parts of his district and he took a keen interest in local progress. It was always felt that he should have had more time to devote to Cornish interests, instead of having to think about safety in coal mines as well. Whether or not it will be possible to improve working conditions in Cornwall remains to be seen. Mr. Martin in giving evidence before the Royal Commission on Metalliferous Mines the other day said: "If I had my own way and plenty of capital, and if philanthropy were the sole object to be considered in mining operations, I

The Alpha Dredge.

would require new shafts to be sunk at almost every mine in Cornwall, and have other improvements effected on the same scale." Probably the new shaft and levels at South Crofty are the only pieces of work that would meet Mr. Martin's views; no doubt the new shaft at Dolcoath is a notable achievement, but the fact that it is circular and brick-lined though passing through granite militates against any inclination to point to it with pride. It has been notorious for years that the conditions in Cornish mines have been dangerous, but whether matters can be put right at a reasonable expense is open to doubt. Much improvement could however be effected by more attention to underground detail.

Electric Station at Hayle.—The Camborne & Redruth Electric Supply Co., now that it has secured the contract with Dolcoath to supply current for that mine's new stamping and pumping plants, intends shortly to proceed with the erection of a large power station at the port of Hayle which should result in a substantial saving in carriage on coal and other supplies. The power will be transmitted by cable to Camborne and Redruth, and eventually the line may be extended to St. Agnes.

NEW YORK.

Copper continues to attract more attention than the other metals. The surplus stock increased 18,441,814 lb. in May and on June 1 the total foreign and domestic visible stock of metal was figured at 400,000,000 lb. Buyers naturally hope for a bargain-day but the hope has been already long deferred. In the meantime there are some startling anomalies. Nevada Consolidated, one of the greatest low-cost producers, now has two furnaces closed most of the time and it is expected that the June output will be less than 5,000,000 lb. As there is an abundance of ore easily available, this can only mean deliberate curtailment on the part of the company. On the other hand the great Washoe smelter at Anaconda, which was built to handle 10,000 tons per day, is now receiving 11,000 to 11,300 tons. The Butte mines, even with the economies possible as a result of recent consolidation, must be rated among the high-cost producers, so that at a time when copper is only bringing 12·30 to 12·50 c. per lb., the low-cost rather than high-cost producers are curtailing. It all indicates that present conditions are artificial, and the best sentiment is to the effect that the great producers are jockeying for position prior to the consolidation, which seems inevitable. When the merger is to be again attempted is entirely uncertain, but that it has not been abandoned is clear.

Bureau of Mines.—The appointment to the position of Director of the Bureau has not yet been announced, but the matter is creating general interest. The leading candidate is J. A. Holmes, now head of the Technological Division of the U.S. Geological Survey. Mr. Holmes is a graduate of Cornell University, sometime professor of geology in North Carolina University, State Geologist of North Carolina, and a man of wide travel and experience. He will be best remembered abroad as having been in charge of the Department of Mining & Metallurgy at the Louisiana Purchase Exposition at St. Louis in 1904. Later he visited England, Germany, France, and Belgium to study mine accidents and he organized the explosions investigations and mine rescue work of the Federal Government and built up the great testing laboratory at Pittsburg. Another man urged for the position is E. W. Parker, chief of the Division of Mineral Resources of the U.S. Geological Survey. Mr. Parker has long been in the Government service as statistician, and his studies of coal production, of briquetting, of smoke prevention, and similar problems have given distinction to the Division under his charge. He served on the arbitration commission that settled the great anthracite coal strike and was also at one time associate editor of *The Engineering and Mining Journal*. As both men are experienced administrators and as it now seems likely that one or the other will be appointed, the new Bureau is sure to make a good start.

Tunnel driving records are heralded on every side. The last to be announced is that made in May at the Laramie-Poudre, an irrigation tunnel being driven in Colorado under the direction of D. W. Brunton, who did such notable work some years ago at the Cowenhoven at Aspen. In the present case the heading from the west end was advanced 332 ft., while that from the east was advanced a distance of 513 ft., thus breaking all American records for a single heading in a calendar month. In January 1909 the Cripple Creek drainage tunnel was driven 435 ft., and in January 1908 one of the headings in the Gunnison tunnel made 449 ft., and in October 1908 the Elizabeth tunnel, near Los Angeles, was driven 466 ft. The rock in the Cripple Creek drainage tunnel and in the Laramie tunnel is very much the same, being hard firm granite in each; whereas in the Gunnison and the Elizabeth the rock was very much softer, and in the latter quite a large portion of it was shale.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

June 1910.	May 1910.	June 1909.
£55. 8s. 11d.	£56. 6s. 11d.	£59. 14s. 11d.

Copper has touched the lowest point since January 1903, falling to below £55, a price which has so often been the turning point in recent years. The strength due to the sound technical position has prevented any distinct slump such as has been witnessed in American railway and industrial shares, but the accumulation of unfavourable features has forced a gradual decline from what must be considered an already moderate level. The continued uncertainties of the crop prospects and of the industrial and political positions in America are at the root of the market's weakness, but copper has been made less assailable by the elimination of the bull element and the firm attitude of the leading producers. American comsumption is by no means satisfactory and it is stated that several railway-equipment orders are being held back until a favourable crop is more assured. The further increase in American production is causing considerable anxiety to the market. In Europe the situation is healthy and strong as is evidenced by the heavy American shipments which are being absorbed without adding to the stocks in public warehouse and by the large deliveries that are still being made from store in England. In spite of these extensive deliveries manufacturers are by no means well stocked and purchases are mostly made for immediate consumption. Stocks are being carried at present by producers and dealers instead of by consumers as in normal times, and until more confidence in the future of the market is assured it is likely that users will continue to follow this policy.

A well planned and sustained bear attack amid the general gloom on the stock markets caused a decline below £55 three months at the middle of the month, but large purchases chiefly against heavy sales to consumers caused a recovery to the old level. When their most pressing needs were satisfied by the dealers prices again showed weakness and at the end of the month the three months price was once more under £55. The Amalgamated Co. has declined to follow the downward trend of the market and the trade has been supplied by the other producers. The latter are now well sold while the prolonged absence of the former from the market has made some grades of copper scarce and the margins between standard and refined qualities are widening. Unless something bordering on a panic ensues, a further fall of price seems unlikely, in spite of the general uneasiness and rumours of difficulties in several of the continental financial circles. The American figures for June provide another disappointment, showing a further increase in production of nearly 2000 tons and an increase of stocks of nearly 4000 tons.

TIN.

Average prices of cash tin:

June 1910.	May 1910.	June 1909.
£148. 13s. 1d.	£150. 1s. 8d.	£133. 4s. 0d.

This metal has been subjected to frequent and violent up and down movements during the month as it came under the alternate influence of the bear and bull parties. American buying of considerable strength alternated with persistent bear attacks, and again the leaders appeared for a time indifferent to the market's fate. The intrinsic position is undoubtedly good and the trade demand satisfactory. Prices have fluctuated between £148 and £151. 10s. for 3 months. Tin closes strong at the highest price under the effects of the decrease of 3469 tons in the visible supplies.

LEAD.

Average prices of soft foreign lead:

June 1910.	May 1910.	June 1909.
£12. 13s. 9d.	£12. 11s. 8d.	£13. 2s. 3d.

Lead remained featureless with limited demand and a dearth of supplies until well towards the end of the month, when an extensive buying movement suddenly developed. Consumers then found the market bare of prompt supplies and there was some competition on all hands to secure what tonnage was available. Notwithstanding the rush for deliveries the rise in price was moderate, holders having met the demand in a liberal spirit.

SPELTER.

Average prices of spelter:

June 1910.	May 1910.	June 1909.
£22. 3s. 2d.	£22. 1s. 1d.	£21. 19s. 10d.

Very little has been doing in spelter and the price has remained steady round £22 to £22. 5s. for ordinary brands. Buyers are badly supplied ahead but the galvanized trade shows no signs of improvement and appears to be resting after its late burst of activity.

THE OILFIELDS OF MEXICO

By H. S. DENNY

Introductory. — Few people realize the magnitude of the present operations in the Tampico, Tamiahua, and Tuxpam oilfields, or the important bearing of these developments on the world's supply of liquid fuel. It is a matter of common knowledge that for several years S. Pearson & Son have been applying large amounts of capital to these oilfields, but, as far as the general public is aware, without tangible result; in fact, the Standard Oil people have done everything possible to advertise the fact that the Pearsons were in difficulties, that they were still importing oil from the United States to keep their refinery at Minatitlan running, and that their operations were resulting in loss. It was generally believed that the Standard Oil opposition to the Pearsons was, in itself, almost an insuperable obstacle to success. Undoubtedly the Pearsons have had no easy task, faced as they were by a powerful opposition on the one hand, and by repeated disappointment on the other; but they have pluckily persevered, and their efforts are now apparently to be crowned with success.

Independently of the Standard Oil and of Pearsons, however, numerous other concerns are at work, and the list of operating companies is constantly growing.

The oil region of Mexico is well situated as regards the disposal of the product. It is penetrated by two magnificent rivers, the Panuco and the Tuxpam, which afford communication through a string of lagoons and canals. The most easterly anticline follows the coast; two important firms, however, are already producing oil in one of the westerly anticlines and arrangements are being made to pipe the product at Tampico.

Geological. — The surface beds of the coastal belt down to a depth of about 400 ft. consist of Eocene calcareous sand, sandstone, sandy limestone, and marl, and below that depth are found Upper Cretaceous marl, and impure limestone, the thickness of which ranges from 1800 to 2500 ft., and finally underlying the whole of these occurs the massive limestone of the Sierra Madre. The whole series of strata has been folded into a parallel system nearly corresponding in strike to the general line of the Sierra Madre on one side, and of the coast on the other, with a general easterly dip. These folds are crossed by transverse depressions, which probably have an important bearing on the site of the important oil areas. A number of conical hills of igneous origin occur throughout the whole petroliferous region, and experience indicates that there is some connection between these vents and the accumulation of oil. Oil has been discovered on the anticlinal arch of at least three of the first series of main folds, and at depths varying from surface to over 3000 ft. The lighter oils are found at a shallow depth. It is believed that the main accumulations occur in the shale immediately overlying the Jurassic limestone, but accumulations also exist in the crevices of the overlying rocks.

Holdings.—The accompanying map will serve to illustrate the immense area now under exploitation, and the approximate distribution of the various holdings. The most important interests are the Pearson, Doheny, Furber, and Waters-Pierce (Standard Oil).

S. Pearson & Son started seven or eight years ago to operate in Mexico with the object of producing crude oil, and of marketing both crude and refined oil. Their refinery was built at Minatitlan, which is near the port of Coatzocoalcos. Their expectations were based upon the possibilities of the territory in the immediate neighbourhood of their refinery; but as the subsequent operations were not successful, they began to explore the country near Tuxpam. They made arrangements with the Furber Oil Co., and assisted in financing the construction of a pipe-line and a light railroad from the Furber oilfield to Tuxpam, in consideration for which they were granted rights over the production of oil from this district. Those who were opposing Sir Weetman Pearson circulated criticisms regarding the wisdom of this arrangement. The possibility of securing any important supply of oil from the Furber fields was doubted, and the Pearson scheme of carrying the pipe-line out to sea beyond the Tuxpam bar, for the purpose of conveying the oil to ocean tank-steamers, was ridiculed.

At the same time the Pearsons began drilling at several points in the Tuxpam district, notably at Tanhuijo and El Portrero. The former property is five miles southwest from Tamiahua and 25 miles south of the famous Dos Bocas gusher. At this property they

Reference on Map	Name of Owner	Cable tools	Rotary tools
A	Tampico Trust Co. (California & Utah capital)	1*	1*
C	Standard Petroleum Co. (Local capital)	1*	
E	East Coast Oil Co. (so-called Harriman)	3	3
F	Mexican Fuel Oil Co. (W.P.O. Co.)	2	
H	Hausteca Retr. Co. (E. L. Doheny)	4	1
I	International F. & P. Co. (Eaton Sands, etc., Pittsburg)	1*	1*
J	Elektra Oil Co. (G. Jeffreys, Engl. cap)	1*	1*
K	R. J. Kerr	1*	1*
L	Mexico Fuel Co. (Leonard & Mount)	2	
M	Mexican Petr. Co. (E. L. Doheny)	8	1
N	National Oil Co. (Chas. Gahnal & Others)	1*	1*
O	Oil Fields of Mexico (P. N. Furber)	4	2
P	S. Pearson & Son, Ltd.	3	3
R	C. H. Rathbone (formerly Pennsylvania Oil Co.)	1*	1*
S	Spellacy Bros. (California firm)	1	1
T	Triggs (California capital)	1*	1*
W	Tampico Petr. Co. (Whittier, California)	2	2

* Ordered.

THE MEXICAN OIL REGION.

have developed two or three shallow flows of oil, at between 100 to 200 ft. of about 300 bbl. of 16°B. per day, and in many respects these wells resemble the first hole drilled by the Doheny Huasteca company at Juan Casiano, which lies 20 miles to the northwest.

A station has been established at Tanhuijo and a six-inch pipe-line has been laid from the wells to the lagoon for the purpose of delivery to tank-barges, by means of which the oil is transported to a 6000 ton storage-tank, on the Panuco river, Tampico, near to the artificial waterway connecting the river with lake Tamiahua. The impression given is that, in the estimation of Pearsons, Tanhuijo represents an area from which a large and continuous supply of oil is to be won. It is doubtful whether the oil struck at the shallow horizon will represent the main body, and probably in depth other flows will be tapped.

At La Laja, and at a depth of 3000 ft., two small showings of a heavy oil, about 9 to 10° B., were obtained, but nothing further is being done at the moment. At Llano Grande or El Portrero two gushers have been 'brought in' at between two and three thousand feet, and it is believed that each of them can yield a thousand barrels per day. Arrangements have been made for a large camp at this point, and there is some intention of constructing a pipe-line, beginning at El Portrero, and running through to Tampico, taking in Tanhuijo and other Pearson properties on the way. The work already being done at Tanhuijo and El Portrero represents the most important of the more recent Pearson achievements, and the production from these two localities alone satisfy their immediate requirements, at the same time giving promise for the future.

The farthest west at which the Pearsons are operating is in the San Luis Potosi district, at a point 25 miles south of Valles, on the Tampico railroad, where they are just beginning to drill. In this neighbourhood a discovery of high-grade oil with paraffin base was made in two wells put down at Tanute, and there are many indications of petroleum on a line projected southeast from Valles.

The Mexican Petroleum Co. is the oldest and most successful oil company in the Republic. Their property, in and around the station of Ebano, on the San Luis Potosi branch of the National line, covers 550,000 acres. They have been actively engaged in exploratory work, and in actual production of oil for some eight years; and in the last five years they are stated to have produced and sold to the railroads, the Waters-Pierce refinery, and other consumers, more than £2,000,000 worth of oil. In the past two years they have had to contend with a great deal of difficulty from water, but they have succeeded in maintaining their production at a daily average of something like 6000 barrels.

The oil occurs in a shale at between 1650 and 1900 ft., on top of a hard blue limestone, which at this point is of great thickness, and which has been traced throughout the whole of the Tampico-Tamiahua-Tuxpam region at depths varying from 1200 to 2700 ft. With one exception, namely at El Portrero, nothing of any consequence has so far been found below this limestone. The oil at Ebano being at from 8 to 10° B. is too heavy and viscous to be pumped, and recourse has been had to the use of steam-coils and super-heaters.

On the Chijol lease, about 1½ miles north of the Chijol railway station, and some 9 miles east of the Ebano, three cable-tool holes have been drilled, two pumping and one flowing, from which about 1200 bbl. per day is obtained of lighter grade than that found at Ebano, having a gravity of about 14° B. The oil is pumped to the Ebano storage tanks.

The Huasteca Petroleum Co., which is entirely independent of the other Doheney companies, owns 150,000 acres located about 65 miles directly south of Tampico, and some 15 miles inland from the coast. The property is known as the Juan Casiano. Development work was begun on this property within the last eighteen months, and the first well put down developed a showing of something like 300 bbl. per day at a depth of less than 250 ft. A second well was started with the result that in less than 90 days two flowing wells good for 3500 bbl. were brought in at about a depth of 1750 ft., the oil produced being 16° B. More recently a new well has been reported about half a mile from the two last named, estimated to be good for 1500 barrels.

A new pipe-line to the Tamiahua lagoon was laid immediately the first two wells proved successful, and simultaneously a storage station was constructed at the lagoon. For several months a steady delivery of 1000 bbl. per day has been made therefrom to Tampico. This, however, is only a temporary arrangement; in the meantime the construction of an eight-inch line from Juan Casiano to Tampico has been undertaken, and is expected to be ready for service by the end of July. This pipe-line will have six pumping stations about 17 kilometres apart. At Juan Casiano two 55,000 bbl. steel tanks have been erected, with four more to follow, and at the Tampico terminal, on the

south side of the Panuco river, three steel tanks of 55,000 bbl. capacity have been built with three more under way.

It is stated that Mr. Doheney will soon start developing the Chapapote and Cerro Azul properties in the Tuxpam river region.

On the property of the **Oil Fields of Mexico** nine wells have been drilled to date; of these eight have been successful, the remaining one being a dry hole to a depth of 2465 ft. This is situated about a mile east of the nearest of the other eight wells, and it might have become a producer if it had been drilled deeper. The area of the Company's leases is stated to be approximately 240 square miles, but as yet exploitation has been confined to the Furber section, a property of some 4000 acres, and the area actually developed does not exceed 1000 acres.

The Furber property is 25 miles from the coast at an elevation of 600 ft., in hilly country. Many seepages exist on the property, and from these the natives have for a hundred years obtained their oil, which they refined in crude native stills. The oil is found at various depths and under varying conditions, at one point being in sand, at others in sandy shale, below a hard and thick stratum of dark blue slate, or in a hard light grey dolomite. The depth varies from 1280 to 1640 ft. in the dolomite; 750 to 1700 ft. in the shale; and 1950 ft. under the blue slate. In their No. 5 hole a flow of 27° B. oil was cut at 1800 ft. in the shale and a small quantity of 41° B. paraffin oil was found in the sandy shale; but eventually the well was blocked and the casing perforated for the 27° B. flow. In the shallow formation the oil is about the same as at Ebano.

Facilities for handling the oil produced from this field have already been mentioned in connection with the Pearson operations; they consist of a six-inch pipe-line to the station on the Tuxpam river, and thence to the storage-tanks at La Barra. The only doubtful point about this pipe-line is the floating line carrying the oil from the storage-tanks out to sea. The working of this terminal length depends on the universal joint used. It is believed by many engineers that silting will create an unsurmountable difficulty. It may ultimately be found necessary to alter this arrangement, and to solve the difficulty by dredging the bar. The river itself is a magnificent body of water, and if the bar were dredged to give a channel from 30 to 40 ft. would make an excellent inland harbour.

The Mexican Fuel Oil Co. or Waters-Pierce company is recognized as the representative of the Standard Oil trust; until recently it has not taken any part in the actual production of oil. In fact the policy of this company was to take in hand only the refining and marketing of the various products, thus favouring the idea that others might do all the exploitation and production, while the Company, with its immense refinery, could regulate the price of crude oil. It was quite clear from the first that the policy of the Pearson house, aiming as it did, firstly, at the production of oil, and, secondly, at the establishment of a refinery, must clash with that of the Waters-Pierce company, and constitute a serious competition, which could only result in reducing the profits accruing to a monopoly. The consumer may be thankful that a corporation with the strength and the pertinacity of the Pearsons did enter the field in competition with the Standard Oil trust.

It would now appear that the Waters-Pierce company has altered its policy and is determined to enter the field of production; it began operations in the Topela or Santa Fe district, not far from Tampico, a little over a year ago, and so far has drilled two wells, the first to a depth of 2600 ft., and the second to 1800 ft. The lease at Santa Fe is said to have an area of approximately 6500 acres. I am informed that in the second hole two flows were encountered, the first at 1830 ft. and the second at 2250 ft. From this well the flow is from 100 to 600 barrels.

Doubtless the Waters-Pierce plans as regards production will expand during the next few years, and with their enormous backing they will always be in a position to cope with competition. Their refinery on the Panuco river, close to Tampico, comprises an up-to-date equipment, and their contracts with the Doheneys and others guarantee them a big supply for many years. The price paid varies from 2 to 3 shillings per bbl., according to the point of delivery and the quality of the oil.

It is rumoured that the **East Oil Co.** decided to abandon drilling operations on the Tuxpam leases near the Tampamachoco lagoon; three wells have been drilled at this point and the work was inspected by me. In one hole, which is 3850 ft. deep, a fair show of heavy oil was struck. The second well was carried down to 450 ft. with cable-tools, but so many difficulties were encountered that it was abandoned; in the third hole, drilled with a rotary equipment and carried to a depth of 3100 ft., nothing was discovered. It is generally believed that a deep well in this vicinity would be productive.

This company, at a point near Mendez in the San Luis Potosi district, has just abandoned a hole at 2710 ft. A small showing was found at the top of the limestone. At Topila, 30 miles up the Panuco river from Tampico, and on a small tributary two miles back from the river, this company has two fair showings in a rotary hole 1950 ft. deep; this hole is to be continued to pick up the same oil-bearing formation that was cut in the No. 1 well of the Waters-Pierce on the south bank of the same tributary. Indications are favourable.

At another point on the Panuco river, two miles from the township of Panuco, a 1500 ft. rotary hole has disclosed two showings, and is being carried deeper. At another point at Tamasi, 30 miles north of Ebano, a combination rotary-cable is being built.

The American International Fuel & Petroleum Co. is drilling on a 90,000 acre lease, known as Los Esteros, between the railway station of that name on the Monterrey railroad, and the Tamasi river. It is stated that this was formerly held by Pearsons, who, after drilling four holes, abandoned it. The present company has put down one hole to a depth of 2550 ft., which it is stated they are now abandoning, and they have a second hole between 1500 to 2000 ft. deep, which has developed a small show of 15° B. oil. It would appear that the formation is extremely difficult to drill owing to the hard layers of limestone between thick water-bearing strata.

In the **Tampico Petroleum Co.,** M. Whittier is the principal factor; he is also the vice-president of one of the largest independent oil companies in California. He has secured 50,000 acres on the El Limon range, lying next to, and southwest of, the Ebano ground. At the present time two combination rotary-cable plants are being erected.

The Spellacy brothers are Californian operators. They have leased 3500 acres within half a mile of the East Coast Co. and the Mexican Fuel Co's well at Topila, and have ordered a combination rotary-cable equipment.

The National Oil Co. is backed by local American and English business men. It is stated that they have under lease 60 square miles of country, mostly in the neighbourhood of the town of Panuco.

Charles H. Rathbone was at one time the prime mover in a Pennsylvanian company that transferred its leases to the Pearsons. It was on one of these leases that the famous Dos Bocas gusher was found. Mr. Rathbone has taken up some large areas in the Panuco river territory, one of them consisting of 20,000 acres adjoining the Santa Fe property of the Mexican Fuel Co. at Toledo. A combination rotary-cable plant will shortly begin drilling on this property.

Among other operators may be mentioned the Standard Petroleum Co., the Electra Oil Co., Robert J. Kerr, the Standard Oil of Mexico, and Sabanillas Oil Co., and many other smaller concerns, some of which are acquiring leases in anticipation of an improvement in value, while others are getting ready to drill.

Drilling. The bulk of this work has been done with the rotary and cable types of equipment, and experience shows that it is advisable to have both types on hand. To begin with, the heaviest type of equipment is necessary because the depth to be bored reaches 3000 ft. or more, and in this particular formation there are many bands of hard shale or occurrences of boulders either of which will create serious difficulties. The cost of the combination equipment is fairly heavy, and if much casing is to be used and pumping equipment provided it would be safe to estimate it at £10,000 or £15,000. Of course, one equipment would be good for a number of wells. In the next few years it may be possible to let contracts to responsible people who will provide their own equipment.

Conclusion. The oilfields of Mexico have in my opinion an important future in store for them. The enormous proved area, the large number of wells drilled, the value of the oil for fuel and refining purposes, the excellent prospects for a home market and the convenient situation and facilities for export, and the high standing and great financial resources of the leading operators are all points in favour of my optimistic views. As far as consumers are concerned the most important event is the passing of the Pearson interests from their period of difficulty to an era of success, which means that the monopoly will be broken down and competitive prices introduced. This breaking of the monopoly is as important to the smaller producer as it is to the consumer; for it is obvious that any ordinary producers could never have competed with the Standard Oil people. There is no doubt that demand will grow rapidly with supply, and with the dependability of the supply. Many local users of fuel who had made arrangements to adopt oil had to revert to coal or wood owing to the difficulty of obtaining regular supplies. These will gladly use oil once more as the production increases, and many other important users will follow in their wake.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Counsels of Imperfection.

The Editor:

Sir—In my haste to protest against what I believe to be a bad doctrine for the young, I find that I allowed myself to misquote Mr. H. C. Hoover, and I should be glad if you will allow me space in which at once to express my regret and correct a wrong impression. Mr. Hoover said: "There can be no objection when such participation does not, either in fact or appearance, conflict with the engineer's independence of judgment, or influence his conduct towards others," and of course as this implies absolute honesty, everyone must be in agreement with such a statement. By omitting the words "in fact" the whole sense is altered. While I do not agree with the teaching of promotion finance to the student engineer, I must, as indeed must all, agree that there are engineers, whose association with such matters, is, by virtue of their established worth and repute, of benefit to all concerned.

HORACE G. NICHOLS.

On the Trans-Siberian Express, May 31, 1910.

[This arrived just too late for our June issue.—EDITOR].

The Weight of Learning.

The Editor:

Sir—I would like to endorse emphatically all that Mr. R. Gilman Brown suggests with regard to the desirability of publishing field editions of technical literature of standard character relating to mining and metallurgical matters. Until recently people entering this Republic were allowed to bring in 150 kilo. of personal baggage free; for any excess over this amount they were charged at the rate of $1·75 per kilo. and although now the Custom House charges are rather easier than they were, 150 kilo. per head is still the maximum that is admitted free, and this is not a large amount if one travels with many books.

It would also be a great boon to those whose work takes them away from their home base, if publishers of technical literature could agree to adopt two or three standard sizes for their books—preferably one size only, if possible. If this were done, instead of books having to be packed, more or less loosely, with general articles, often of a damaging nature, it would be practicable to have an air-tight uniform case arranged with fixed shelves so as to become a travelling book-case, in which (on account of the standard size of the books) it would be feasible to pack them so that no shifting, even after several days freighting on a pack-mule, would result. On arrival at the destination a simple opening of the case would make a suitable book-case, which could be kept shut when not in use, so that in tropical climates it would be possible to exclude the insects and damp which, together or singly, deface the bindings of books to such an extent that their titles cannot be deciphered.

It may be too much to ask publishers of their own initiative to agree, among themselves, to publish field editions of a standard size (as regards length and width) but possibly something towards this desirable end could be done if authors of mining books (as yet unpublished) would stipulate that their contributions were to be issued of a standard size (10 by 7 in. would probably be as convenient as any) and that an edition—the only one if necessary—was to be printed on paper as light and thin as possible consistent with extra cost and satisfactory printing.

GEORGE P. CHAPLIN.

Barranquilla, Colombia, May 23.

Auriferous Scorodite at Gwanda.

The Editor:

Sir—I notice in your May issue, just to hand, a note on the above subject.

May I ask you kindly to give place in your columns to this letter and extracts from the *Rhodesian Mining Review* of April 20 and June 1, respectively. Probably the latter will best explain the matter.

A. E. V. ZEALLEY.

Bulawayo, June 4.

"I have examined some fifteen samples from seven independent sources. All the specimens are scorodite (hydrous iron arsenate) in its various forms. Some contain visible gold. Some show the mineral from which the scorodite was formed, namely, arsenical pyrites. Most of the samples contain some vein quartz, whilst some show the last of the three stages of alteration of the arsenical pyrites—namely, the formation of hydrated iron oxide (limonite), etc. From the facts to hand, there can be no possible doubt that the 'formation' is the gossan of a lode of arsenical pyrites; the quartz being present, as in most mineral lodes, as a veinstone. Apparently the lode is in "banded ironstone," but no specimens of the walls have reached me. The "banded ironstone" country,

I am informed, carries gold also. As to the presence of the gold in the scorodite, it is most likely that it results from that metal being an original impurity contained in the arsenical pyrites. I have seen no gold in the quartz, although, of course, it may yet be revealed upon development. In conclusion, I should like to state that the occurrence is in no way abnormal, but is exactly what might be expected. It is erroneous to regard it as a new formation for the occurrence of gold. The same thing is encountered elsewhere in Rhodesia, as I mentioned before. It is also described as occurring in the gold mines of parts of Australia associated with quartz, mispickel and gold, this being precisely the case in Rhodesia."

[We quote the descriptive portion of a letter written by Mr. Zealley, the geologist to the Rhodesia Museum, to the *Rhodesian Mining Review*. In that journal it is also stated that the same mineral, scorodite, has been detected in the Champion, Cairn Dhu, and other mines in the Umtali district.—EDITOR.]

Mining in Siberia.

The Editor:

Sir—Having had some personal experience in managing a gold placer mine in East Siberia I take the liberty of entering this discussion. The subject is too large to be hurriedly treated, and I suggest that the mining engineers who have been engaged either in examination work or in operating in Siberia should express their views before one of the winter meetings of the Institution of Mining and Metallurgy. In this discussion Russian engineers and mine-operators might be invited to participate, for example, Messrs. N. N. Kerrmakof and Barbot de Marmy, the able chief and assistant-chief of the Mining Department at St. Petersburg, Baron Alfred Gunzberg of the Lena company, and Mr. P. V. Mordin, the most successful and up-to-date placer miner of East Siberia.

Thus English and American engineers could obtain authoritative statements at first hand regarding the attitude of the Russian Government toward the rights of foreigners and foreign-invested capital. To this conference Mr. Jafet Lindeberg would also undoubtedly come, if invited. The results could not fail to be of definite importance.

Of Siberian mining outside of placer gold mining I know nothing. In that portion of Siberia west of Irkutsk I take only a passive interest. The Siberian area to the east of the longitude of Irkutsk contains what is probably the untouched store of alluvial gold of the earth's surface. Every engineer concerning himself with the various forms of gold-gravel mining, if he be of sufficient standing to command work in other countries will probably have visited some part of East Siberia within the next decade. Various properties will be turned down. Some will be favourably reported on. Large sums of English capital will be called for the development of colossal areas. Is this capital to be legally recognized or not? That is what the investor rightly wants to know.

The Lena Goldfields offers the example of a rich deep-lead mine financed in England and operated entirely by Siberians. Other properties of the Vitim district will probably pass into English hands, as several of them are for sale. Are these English companies to be prevented from putting their own legally recognized managers and staff in charge? Is the example of the Lena to form a precedent? Probably not. English companies generally employ managers who know something of modern methods, and endeavour to reduce working costs. Russians are not celebrated in the annals of mining for low working cost.

Why is London flooded with Siberian gold mining properties for sale? Because with extremely rare exceptions Russia affords neither the capital nor the technical talent to operate gravel mines at a profit. Men qualified to cut down costs and cut out worthless hand-labour are impatient of archaic regulations designed for illiterate peasants. Investors in Siberian gravel mines have a right to demand as free a hand to develop their properties in their own way as does the miner in Alaska or the Klondyke. Unless they do demand and obtain these privileges, their engineers will find themselves handicapped and even brought to a stand-still.

Mr. Jafet Lindeberg is now reported to have recovered $77,000 from the acting-governor of Chukotsk and Col. Volnarlarsky. It is to be hoped that this is true. Instead of being driven out from the Pacific coast of Siberia, Mr. Lindeberg should be asked to take charge of its development. He is the man above all others best fitted to get the gold from the creek-gravels of the Siberian coast.

C. W. PURINGTON.

Honolulu, June 6.

Zinc Fume.—According to the Alkali Inspector's Report for 1909, all the zinc smelters in South Wales are experimenting with devices for preventing the formation and escape of zinc fume, and four separate patents have been granted or applied for.

PERSONAL

J. W. ABBOTT was recently in hospital at Salt Lake, but has recovered and is now at Pioche, Nevada.

FERGUS L. ALLAN has resigned as manager of the Mexico mine of El Oro, in order to live at a lower altitude.

ARTHUR R. ANDREW is here from Dunedin, New Zealand.

HOWLAND BANCROFT is completing a geological reconnaissance in the State of Washington.

A. C. BEATTY was in Paris recently.

T. BRUCE-MARRIOTT has returned from the northern Transvaal.

EDWIN BURT has moved from El Oro, Mexico, to El Paso, Texas.

GEORGE P. CHAPLIN has opened an office at Barranquilla, in Colombia.

WALFORD R. DOWLING, reduction manager at the Knight's Deep Mine, will return to the Rand in September.

S. F. EMMONS is at Dinard.

C. FERNAU is in Bolivia.

S. S. FOWLER sailed for New York June 29, going to Marysville, Montana.

L. S. GRISWOLD has resigned the chair of geology in the Missouri School of Mines.

W. A. HEYWOOD left for Cordoba, Spain, on July 8. He will return to London on August 7.

W. L. HONNOLD sailed for New York on June 24.

G. H. J. HOOGHWINKEL left for the West Indies and Mexico on July 6.

EDWARD HOOPER has been in hospital with an injured knee, but is now well again.

HOOPER, SPEAK & FEILDING have been appointed consulting engineers to the Anglo-Ottoman Oilfields, Ltd.

L. HUMPHREYS has been examining mines in Arizona.

ALFRED JAMES returned from Mexico on June 21.

S. RAMPLEN JONES has opened an office as consulting engineer at Ipoh, in the Federated Malay States.

JOHN LAIRD Jr. has returned to England from Tominil, in Durango, Mexico.

RICHARD H. L. LEE will arrive in London from China on July 25.

ALBERT R. LEDOUX made a short visit to London, from New York, in June.

J. T. MARRINER is temporarily at Frinton-on-Sea, in Essex.

LOUIS J. MAYREIS has returned from Bolivia to Collahuasi, in Chile.

E. T. MCCARTHY has been appointed consulting engineer to the Palmarejo & Mexican Gold Fields, Ltd.

W. W. MEIN is temporarily resident at South Kensington.

FRANK MERRICKS has returned from Venezuela.

J. W. D. MOODIE has returned to Los Angeles, California.

F. L. MORRIS is at Dawson, in the Yukon.

C. H. MUNRO returned to Nome, Alaska, in June.

P. N. NISSEN is here, on his way to the Rand.

J. C. PICKERING, after a short visit to London, returned to Mexico.

J. B. RISQUE has resigned as general manager for the Utah Consolidated Mining Co., at Bingham.

HORACE P. ROBERTSON, on his return from South Africa, is at Loughton, Essex.

A. P. ROGERS, NORMAN STINES, and ROSS HOFFMANN will assist J. P. HUTCHINS in testing alluvial deposits in the Nerchinsk district, Siberia.

W. R. RUMBOLD has accepted an appointment with the Royal Niger Co., and sailed for Lagos on July 6.

H. KILBURN SCOTT is in British East Africa.

F. F. SHARPLESS having completed his work in the West Coast of Africa, has returned to New York.

S. F. SHAW has gone to Montezuma, Costa Rica, to start operations for the Montezuma Mining Co.

A. E. THOMAS has returned from Brazil.

ARTHUR WADE left for Turkey on June 25, to report on oil properties on behalf of the Anglo-Ottoman Oilfields, Ltd.

E. R. WOAKES left London on June 17 to examine mines in the Caucasus in behalf of Hooper, Speak & Feilding.

C. W. WRIGHT is returning to Washington to remain there until September, when he will return to Sardinia.

METALLURGY ON THE RAND

By HORACE G. NICHOLS

A SHORT trip made recently to South Africa, revealed many interesting conditions on the great goldfield tributary to Johannesburg. The most salient feature is the high degree of fineness and extreme solubility of the gold, characteristics that go far to justify the adoption and retention of a process which under other conditions and in other countries has been condemned. The treatment of the washed slime from banket ore provides no incentive to improvement upon decantation. The merest trace of cyanide is sufficient for solution of the gold. A strength of solution can therefore be used so low as to permit of no difference between that used for the extraction and that used for the washing; thus only the solution recovered from the first decantation is precipitated, while the time occupied in the ordinary method of transfer is all that is required for the purpose of extraction. Local conditions are changing, however. Between the coarse sand and the washed slime comes the fine sand, which, within limits, can be included with the percolation product; but with the introduction of the tube-mill has come the need for making special provision for the treatment of the larger percentage of finely ground sand, which is not suitable for percolation and which defies the casual treatment imposed upon the millman by the inherent limitations of simple decantation. That these limitations are felt is indicated by the many attempts now in progress to improve conditions. The excellent results obtained at the New Modderfontein show that time and space are needed for decantation, but the generous dispositions that are here exhibited are not always possible. The Adair-Usher process of displacing solution by the introduction of wash through perforated radiating pipes in the bottom of a vat seems to increase capacity, but not to benefit ultimate results as shown by the assay of the residue, while the difficulty of accurate sampling is cited as a disadvantage. The introduction of air, for agitation, through these pipes is being tried at the Robinson and is a step in the right direction. At the Ferreira auxiliary treatment by mechanical stirrers is used, and there are many other ways of eking out the possibilities of the process. Upon the East Rand Proprietary Mines, however, devolves the greatest amount of interest. Here the long-awaited trial is at last being made on a large scale of treatment by agitation in Pachuca 'tanks,' dewatering and recovery of solution being effected by distinct steps and appliances. The experiment is being carried one step further, to the point of treating the whole mill-product without classification, using a slightly stronger solution, about 0·04% KCy, still weak enough to allow of the 'one solution' idea being followed, and relying upon the higher ratio to give the required amount of cyanide.

Treatment in series is to be tried; its success will depend upon the ability to regulate the overflow of sand and slime from the central column. A specially constructed diaphragm is being used for this purpose. The Arbuckle machine, which is being used for dewatering and recovery of solution, is an ingenious adaptation of the Howartson filter principle, and while there may be room for a better method of withdrawing the solid portion, no one can view this attempt to deal with the vital point in slime-treatment in a rational way with other than deep interest. To some engineers, the attempt to discard classification does not appear to be demanded; on the contrary, the idea is favoured of improving classification to the extent of freeing the coarser sand of all fine material, which latter product can, with the introduction of air-lift agitation, be left safely with the slime, and so produce an ideal leaching product. With this object in view conical classifiers are replacing the old spitzkasten, and are being fitted with diaphragms, which are found to improve the underflow by preventing channelling. The Caldecott sand-table provides for a further step in sand-treatment, rendered possible by this more through cleansing of the sand, which is scraped from it carrying 14% moisture and pumped with weak solution to the collecting-tanks which thus virtually become first-treatment vats. It is noteworthy that but little extraction is effected in this pumping stage, the solution presumably being too weak, but improved extraction is ensured with the subsequently added strong solution.

Tailing-wheels are disappearing. In their place I found pumps handling 7 tons per min. of 2 : 1 pulp, at low cost; the whole expense of pumping at the Village Deep is said to be 15s. 6d. per day.

Several new features are being introduced

FERREIRA CYANIDE PLANT.

CONICAL CLASSIFIERS BEING INSTALLED IN PLACE OF SPITZKASTEN AT THE KNIGHT'S DEEP.

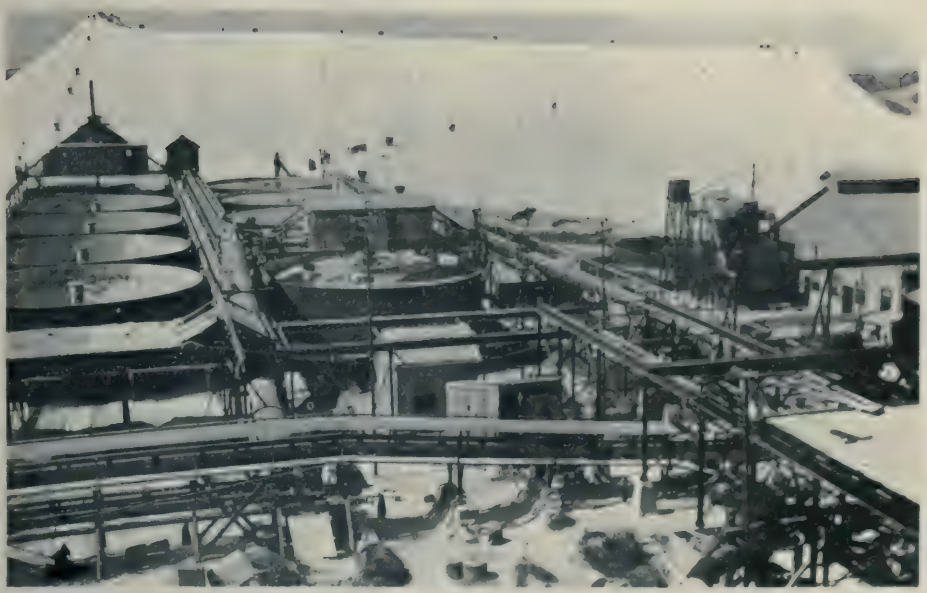
with the ferro-concrete construction at the City Deep plant. Every stress and strain is carefully anticipated and all the more important parts are reinforced with special half-inch indented steel. The king-posts for supporting the new Laschinger battery-frame seem especially daring and are made of concrete mixed in the proportions of 4, $2\frac{1}{2}$, 1. Much is expected from this solid cast frame, which provides nearly 100% extra cam-shaft bearing. Battery plates are not included at this mill, the crushing being coarse, but 63 shaking-tables serve the 9 tube-mills, which follow the two hundred 2000 lb. stamps with 9 in. boss-heads. Questions relating to the tube-mill circuit are naturally receiving much attention and a good departure is the tandem grinding and tandem classification to be adopted at the Crown Mines. In this system the + 60 product from the tube-mill classifier is passed to a second tube-mill instead of being returned to the pulp flowing to the first tube-mill.

Double-tier sand-plants are not being erected. Tailing-stackers are doing good work, and at the New Kleinfontein the whole cost of handling the tailing is said not to exceed $2\frac{3}{4}$d. per ton. A great deal more has been done and is being done in justification of, and in improvement upon, the old decantation process than the average outside engineer understands. The foregoing notes are not intended as a criticism but as an introduction to the accompanying photographs, which I was allowed to take by the unfailing courtesy of the many engineers and others who made my two months' stay on the Rand a most pleasant experience.

Importing Tanks into Mexico.—It will interest manufacturers of tank material to know something of the terms of the Mexican tariff. Sheet-steel is subject to a tariff of 12 pesos per 100 kilo. As this is hard on the mining companies, a reduction was made in favour of 'tank material,' provided it was for large tanks and sent in prepared pieces. In this case, steel plates cut, punched, and formed are subject to a duty of only 1·65 pesos per 100 kilo. If, through any error in despatch, part of the material is sent on a separate steamer, without duly advising the Customs authorities, the whole shipment is liable to be charged at the old rate. This actually occurred in one or two cases, and has been the cause of serious friction between shippers and purchasers. In one case the rivets were accidentally omitted from the shipment and were sent by a later steamer. These were then held up as not being tank material, and had to pay a fine for wrong description as well as a special tariff. In another case the first few courses of a large number of tanks were sent first, and the top course and launders by a second steamer, with the result that both shipments were made to pay the higher duty. It is, therefore, essential that shippers, when they cannot fill the order at once, should state in the bill of lading that the first shipment is not a complete one, and thus ensure that the material sent later shall receive preferential treatment.

The Bettington-Robeson Boiler is the latest invention for utilizing coal-dust for steam-raising purposes. It is made by Fraser & Chalmers and is being adopted at several mines in South Africa. Many attempts have been made to burn coal dust in boilers and there are two reasons why such a method of combustion is advantageous: first, air is more efficiently mixed with the combustible; and second, waste fuel can be utilized. Many practical difficulties have hitherto stood in the way of success, chiefly the production of too high temperatures locally. The design of the Bettington-Robeson boiler diminishes this disadvantage. It is of the vertical type and consists of top and bottom drums connected with three sets of vertical tubes arranged in concentric rings close together. The central upright cylindrical space is wide and a lining of firebrick is built up by means of rings placed round the inner set of tubes. The burner is at the centre at the bottom and the current of dust and air on ignition flows direct up the centre and, impinging on the top drum turns toward the outside and travels downward in contact with the firebrick. On arrival at the bottom it passes below the firebrick and comes in contact with the tubes for the first time. It travels up along the inner set and down again in contact with the outer set, and finally the gases are discharged, passing subsequently through an economizer for heating the feed-water and then through a heater for heating the air fed to the burner. The inside lining of firebrick is intended to protect the first tubes, which in their turn abstract heat from the brick and prevent it from melting.

The pulverizer and fan are one and the same machine, the coal being fed through a hopper and pulverized by the blades of the fan. The air and dust first go into a chamber, where the coarser particles of coal settle, and then through the heater and on to the burner. The blades of the fan can be regulated so as to vary the amount of air drawn in. The draught through the boiler is supplied by this fan.



THE BIG PLANT AT NEW MODDERFONTEIN.

FERRO-CONCRETE FOUNDATIONS FOR SAND-VATS AND BLAISDELL EXCAVATORS AT THE CITY DEEP.

MILLING OF LEAD-SILVER ORE. III.

By GELASIO CAETANI

FINE SCREENING. — The Bunker Hill screen, as shown in Fig. 8, is a conical screen mounted on a spider with a hollow shaft set at an angle of 45° through which the over-size is discharged. The screen revolves at a speed of 20 r.p.m. and the pulp is fed across the downward moving portion of the screen. The over-size clings to the screen-cloth by adhesion and by centrifugal force, and, when elevated almost vertically over the discharge-opening, it falls off partly by gravity and partly by the action of a spray of water directed tangentially to the screen. The screen-cloth is 22 mesh No. 26 gauge steel wire. Each screen handles per 24 hours from 50 to 80 tons of pulp not coarser than 2 mm., but if necessary it will handle double the amount for periods of an hour or two. The volume of pulp can be as high as 200 gal. per min., but 100 to 120 gal. per min. is the right load. The screen is cut out of a 47 in. cloth and has an area of 20 sq. ft., of which about 3 sq. ft. are fragments available for patching. The cloth will last over two months ; the wear is confined almost entirely to the inner periphery, where the cloth is clamped to the central cone and after 30 days service it is necessary to apply a circular patch. The screen does not easily choke ; a steel brush held against the inner surface for a few seconds will free the screen completely. Care must be taken not to allow the steel wire to rust during protracted shut-downs ; this is done by drying the screen roughly with some cotton-waste and then wetting it with gasoline.

The Bunker Hill screen has entirely replaced the Callow screen, which was formerly in use. The cost of the screen-cloth per ton of ore treated is about one-third ; the cost of the machine itself is about one-half, and the capacity is greater. The Bunker Hill screen also presents the great advantage that, not being subject to any bending, it never cracks, but simply wears until the cloth gives way and has to be repaired. For repairing, the set-screws holding the spider are loosened, the whole spider removed and replaced by a new one, an operation that can be performed in less than one minute. Finally, the Bunker Hill screen does not need continuous repairing of the cloth and therefore any over-size seldom finds its way into the under-size. If the screen stops rotating, the pulp piles on top of the cloth and overflows through the over-size discharge instead of running into the under-size as is the case with other screens.

The Bunker Hill screen is best adapted for screening from about 6 mesh to 80 mesh ; for screening finer than 80 mesh the Callow screen, I believe, is more suited, though I have never had an occasion to test this point.

As previously mentioned, the 22-mesh screens are, so to speak, the entrance door to the table-concentrating department, as nothing can enter this department without passing through the screens. For the further subdivision of the feed I believe that a good classification is preferable to fine screening, being a cheaper and more fool-proof device and yielding a pulp more suited for table work.

CLASSIFIERS : The classifiers are of a pattern developed in the Bunker Hill mills and their general construction is shown in Fig. 9.

The speed of the upward current is given by the difference of level between the top of the partition *A* and the overflow edge *B*. If the volume of the supply is greater than the volume of the rising column in *C*, then the excess of pulp flows over the top of the partition *A*. The speed of the upward current in the spitzlutten *C* remains practically constant whatever be the bulk of the supply. The triangular compartment *D* acts as a spitzkasten in which all the sand settles, to be afterward classified in the spitzlutten *C*, and only the slime can flow over the partition *A*. Very little hydraulic water is used, and the classifier will not choke or get out of order even when not looked after for weeks at a time. It is almost 'fool-proof.' The finest sand is separated in the slime-classifiers, which consist of two conical tanks, concentrically placed. The inner cone is flatter than the outer one and the annular space between the two has a constant cross-sectional area. The pulp is fed at the centre, while the fine sand is separated by spitzlutten action in the annular space and discharged by a goose-neck.

The four discharges of the classifiers are distributed to Card tables by means of pocket-launders, illustrated by Fig. 10. The main object of the pockets is to distribute the pulp, though by their special construction they also effect roughly a second classification of the four classified products. The usual method of

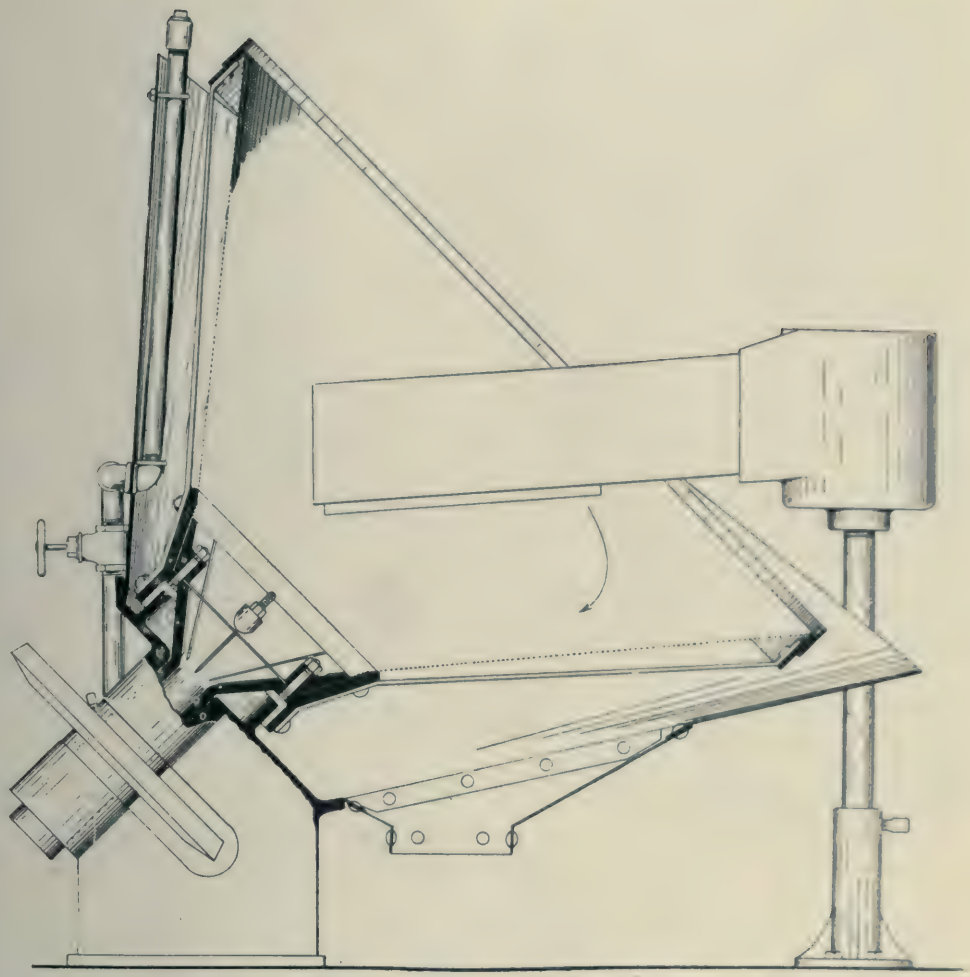


Fig. 8. BUNKER HILL SCREEN.

TABLE VI. SCREEN-ANALYSES OF PULP GOING TO CARD TABLES.

Number of Pocket	Classifier First Spigot						Classifier Second Spigot					Classifier Third Spigot			Slime Classifier			
	1	2	3	4	5	6	1	2	3	4	5	1	2	3	1	2	3	4
Percentage on																		
40 mesh	16	16	14	10	4	1	2	1	1	–	–	–	–	–	–	–	–	–
„ 60 „	36	36	34	28	19	6	16	14	10	6	1	2	1	–	–	–	–	–
„ 80 „	27	37	29	28	29	19	38	31	31	27	8	14	12	6	2	2	1	–
„ 100 „	10	10	11	13	16	17	23	23	27	26	17	19	19	14	7	6	6	3
„ 150 „	6	6	7	9	13	17	15	17	19	24	25	26	23	20	20	17	18	13
„ 200 „	3	2	2	3	5	8	4	6	5	7	16	14	13	15	15	13	14	12
Through 200 „	4	3	3	9	13	32	3	8	7	10	33	25	32	45	56	62	61	72

dividing the flow by means of splitters is unsatisfactory because the pulp in a launder always takes a tortuous and variable course, with the result that the supply to the individual tables continually changes.

The double classification effected by the classifiers and pocket-launders is shown in the accompanying screen-analyses. See Table VI.

RECIPROCATING TABLES: The process of table-concentration is shown on the flow-sheet, Fig. 2. The pulp sent to the reciprocating tables is classified as closely as possible without, however, attempting to separate all the slime from the fine stuff as it was found that the slime can be separated on tables more simply and effectively, and with less consumption of water than is possible to do with classifiers. The reciprocating tables will handle with advantage even sand that will pass a 200-mesh screen and can do better work on this material than a vanner. The slime itself will yield some of the galena on a reciprocating table, though the bulk of it is separated as head-water, and after thickening in settling-tanks it is concentrated finally on vanners.

The concentrates are divided in three classes: (1) High-grade concentrate assaying 77% lead; (2) Second-class concentrate; and (3), Low-grade concentrate. The second class is re-treated on grading-tables with the object of separating some more high-grade concentrate, which can be sold at a higher price per pound of lead than the other products. The middlings are divided into two classes; that of the fine table is re-concentrated on special middling-tables into concentrate and tailing, the material being too fine to make further grinding possible. The middling of the coarser tables and of all the grading tables is re-ground through 40 mesh and returned. The tailings go to waste and the head-water or slime is pumped to the settling tanks that feed the vanners. The actual flow of the products is more complicated than is shown in the flow-sheet, but these complications are due to special economical reasons and have no metallurgical importance.

The Card concentrator is the only reciprocating table used in the West mill. Most of the other tables on the market were tried, and it is fair to say that the difference in efficiency between the various tables is not great. Any well constructed reciprocating table will give good results on well classified sand and the main factors that determined the choice of the table to be used in the new mill were mechanical. It must be said, however, that the Card has constantly effected a slightly higher silver extraction than any of the other tables. The reason of this is due probably to the fact that there is a certain silver mineral, not yet mineralogically determined, with a tendency to concentrate along the dividing line between the low-grade concentrate and the middling streak of the reciprocating tables. The Card, by spreading the discharge-products over a wider area, makes it possible to make a sharper division between concentrate and middling and therefore to separate with the concentrate part of the silver-bearing mineral, which on other tables has to be separated with the middling, owing to the narrowness of the dividing line.

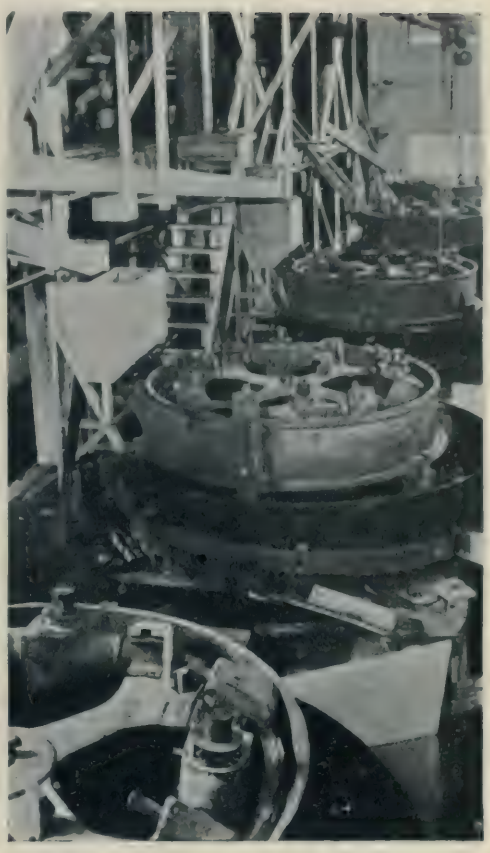
The advantages of the Card as against the Wilfley table is a sharper return stroke with consequent greater progression and capacity, and increased simplicity in the method of suspending and adjusting the table. The Card also has the advantage of spreading the concentrate over a larger area owing to the grooves, which, gradually becoming shallower, extend to the end of the table. The point of division between the high-grade and the low-grade concentrate, and between the latter and the middling is less sharply defined and the adjustment of the table therefore is less affected by variations in the volume of pulp than is the case with other tables. The worst feature of the Card is the frequent breaking of the supporting springs, but this trouble is being gradually overcome. The Overstrom table has, in my opinion, the best head motion of all and also a good suspension, but the separation of slime and tailing along the discharge edge is not clearly defined and the table is therefore not suited to act as a slime-classifier.

The capacity of the reciprocating tables, on the pulp delivered by the hydraulic classifiers (see sizing analysis previously given) is: First spigot discharge, 18 tons per 24 hours; second spigot, 10 tons; third spigot, 5 tons; slime-classifier discharge, 3 tons. These are the tonnages estimated in the design of the West mill and represent the maximum load at full efficiency; but the tables will stand about 20% overload without greatly losing in efficiency. When, however, the tables are overloaded the tailing-discharge spreads back toward the headwater-discharge with the result that it becomes impossible to separate all the slime without cutting into the tailing-discharge, or to separate the tailing free of slime. As to the volume of the pulp, it was found that it can vary from 8 to 12 gal. per min., and 10 gal. per min. was the average assumed in calculating the spigot-openings of the classifiers. The average wash-water used on the Card

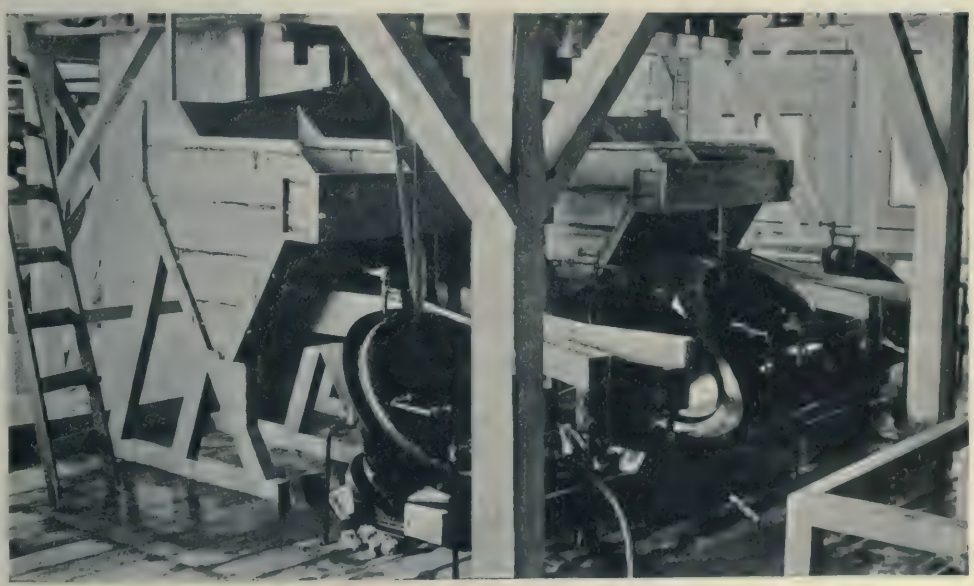
tables is 8·9 gal. per min., not counting the amount used as head-water to sluice the products into the launders.

The Card concentrator must have a fairly rich pulp to perform good work, that is, the ratio of concentrate to other products ought not to be less than 1 to 15, because this table, much more than the Wilfley, has to bed itself. A Wilfley, in starting empty, or when operating on a scant supply of pulp, will not get seriously out of adjustment, as the band of sand, lying diagonally across the table, will gradually expand or dwindle to a narrow streak, without moving far away from the diagonal marked by the terminals of the riffles. The Card table instead, when starting empty, will throw a great part of the middling toward the concentrate-discharge, until the deck has become bedded, when the lower-grade particles will start rolling over the concentrate that fills the riffles, and the table assumes again its normal working conditions.

For clearness of argument, I shall mention some facts known to all metallurgists. On a reciprocating table the separation of the heavy mineral from the gangue is due to the combined action of the longitudinal progression caused by the reciprocating motion and to the transverse motion due to the film of wash-water flowing over the inclined deck of the table. The heavy mineral settles on the deck-surface, causing the lighter mineral to float on top, just as oil floats on water. The recipro-



Huntington Mills.



THE BUNKER HILL SCREEN.

cating motion keeps the mineral particles in a state of semi-suspension and under these conditions the mixtures of mineral grains and water behave like liquids of heavy specific gravity. The heavy mineral, being in direct contact with the surface of the deck, feels the full effect of the reciprocating motion, whereas the upper layers only receive the motion through the intermediation of the motion—to and fro—of the intermediate layer of mineral; thence the progression of the upper layers is therefore less pronounced.

To these conditions must be added the fact that the larger particles of mineral present a larger surface to the flow of wash-water; the moment that tends to make them roll over on the inclined surface, increases as the fourth power of the diameter, whereas the weight only increases as the cube. Thus the tendency to roll is far greater for the large than the small grains. The result of this double effect of longitudinal progression and rolling side motion is to move forward the small heavy grains and to roll the large and light particles of gangue toward the tailing-discharge. When the pulp has been perfectly classified, by hydraulic classification, the diameter of the individual grains is inversely proportional to their specific gravity. The mineral particles will tend to separate on a table under the combined effect of longitudinal progression and of transverse rolling, with the result that a table will distribute the products along the discharge-lip according to the diameter of the grains. Therefore, on a perfectly classified pulp, a table would act as a perfect sizing machine.

The theoretical considerations just given and the experimental results induce me to believe that hydraulic classification is preferable to fine screening, although a perfect classification can never be obtained in practice. An imperfect classification is shown by the streaks of fine and coarse sand that form along the bands of concentrate, middling, and tailing.

In practice, there is a limit to the fineness of the ore particles that can be saved on a reciprocating table. If the particles are extremely minute the action of gravity becomes insignificant compared to the frictional resistance of the water, and these particles are carried along by the water independently of their specific gravity. If just large enough to settle on the surface of the table, the fine concentrate either will pack into a solid film, or remain in contact-suspension, that is, will touch the deck on and off, and go into suspension. Under these conditions the progressive effect of table motion on the fine concentrate is practically killed.

On a vanner the finest mineral is allowed to settle on the belt and, as soon as settled, it will

SLIME-JIG v. WILFLEY TABLE.

	JIG			WILFLEY		
	Tons 24 hr.	Lead %	Silver Oz.	Tons 24 hr.	Lead %	Silver Oz.
Pulp	4·0	13·4	8·2	7·0	13·8	8·3
Concentrate	0·5	77·2	34·3	1·2	62·0	31·4
Middling	0·7	11·8	11·1	1·4	9·4	8·1
Tailing	2·8	2·9	2·4	4·2	2·8	2·0
Slime	——	——	——	0·2	14·5	9·1
		%	%		%	%
Free mineral in middling recovered by re-concentration		40·0	35·0		55	51
Vanner extraction on slime		——	——		50	45
Total recovery		76·3	63·0		81·3	74·7
	Weight %	Lead %	Silver Oz.	Weight %	Lead %	Silver Oz.
Sizing assay Test on tailing: On 20 mesh	15·2	0·90	0·8	2·2	1·05	0·6
„ 40 „	34·7	1·03	1·0	24·0	2·20	1·2
„ 60 „	20·7	1·70	1·4	30·9	2·90	1·8
„ 80 „	15·2	3·55	2·9	27·0	3·20	2·1
„ 100 „	5·5	4·85	5·5	9·2	2·98	2·4
„ 150 „	3·3	9·60	10·3	4·1	2·92	2·2
„ 200 „	·5	26·30	17·7	·9	2·40	1·9
Through 200 mesh	4·9	19·80	13·3	1·7	9·60	6·3
TOTAL	100	3·07	2·50	100	2·89	1·85

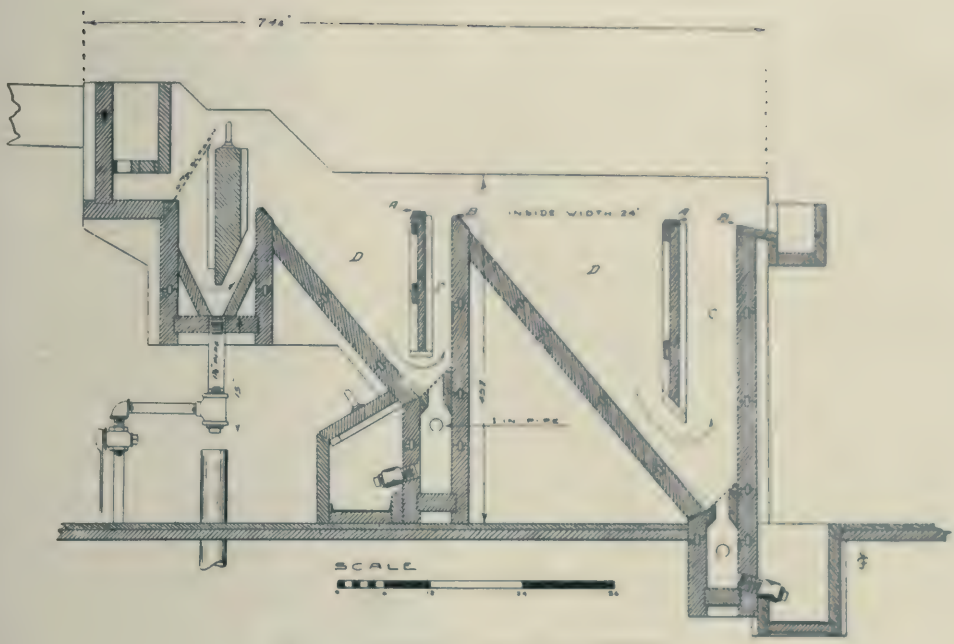


Fig. 9. CAETANI'S DUPLEX CLASSIFIER.

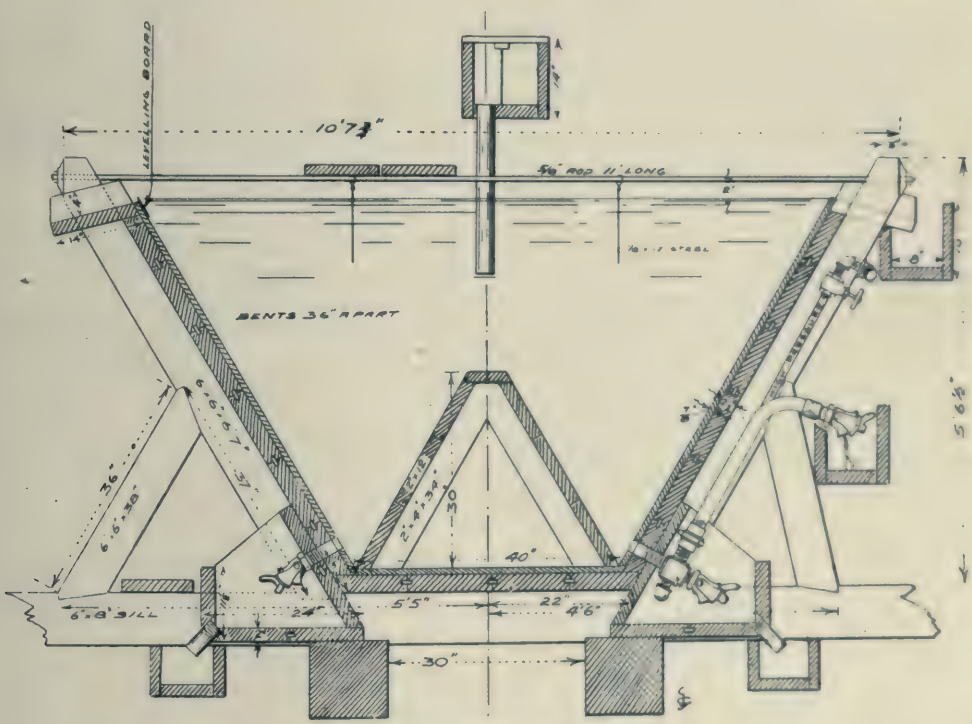


Fig. 12. SLIME-SETTLING TANK.

pack and cling to the surface; then by moving the belt to where it can be washed, the concentrate is removed. The vanner therefore has this advantage over the reciprocating table, that where it becomes impossible to make the ore progress on the dressing-surface, the surface is made to progress with the ore. It is for this reason that all the reciprocating tables tried on vanner-pulp have been a failure, as will be explained later.

An interesting parallel test was run between slime-jigs and Wilfley tables, with results as shown on page 52. See also Fig. 11.

These tests lead to the following conclusions:

(1) The capacity of a jig is about one-half that of a Wilfley.

(2) The jig-mill yields a cleaner concentrate.

(3) The jig-middling contains less free galena than the Wilfley.

(4) The jig-tailing is about the same grade as the Wilfley-tailing.

(5) The coarser sand in the jig-tailing is lower-grade and the finer sand is much higher-grade than in the Wilfley-tailing.

(6) The Wilfley separates the slime that is lost on the jig.

(7) The Wilfley table yields a higher recovery than the jig.

(8) The jig needs artificial bedding.

(9) The work of a jig cannot be inspected at a glance like that of a Wilfley and requires more skilled labour.

(10) A jig will require more power, water, and repairs than a Wilfley table, and also involves a greater loss of grade.

VANNERS: We have seen that the Card table will handle even the very fine sand to better advantage than the vanner, and that the vanner will do better work on slime passing all through 200 mesh than any reciprocating table can do. The galena contained in the slime is extremely difficult to save and the difficulty increases with the fineness of the slime, as can be seen by the analysis made of the average vanner-tailing given in Table VII.

Many machines were tested against the Frue vanner: the Wilfley slime-table, Craven slime-table, Johnston vanner, Deister table, Dimmick pin-table, round tables and canvas plants. They have all been variously unsuccessful. The 6-ft. Frue vanner has given the best results and it is this machine that is now used

TABLE VII.

	Assay of Vanner Tails Lead %	Silver Oz.
Through 200 mesh and settling in 6 mm. current	1·10	2·96
Not settling in 6 mm. and settling in 3 mm. current	8·10	4·58
Not settling in 3 mm. and settling in 0·3 mm. current	13·55	7·06
Not settling in 0·3 mm. current	18·05	8·80
Assay of Pulp	18·00	9

TABLE VIII. AVERAGE DATA ON 6 FT. FRUE VANNERS.

Characteristics of Test	Pulp Tons per 24hr.	Pulp Lead %	Pulp Silver Oz.	Pulp On 200 mesh %	Concentrate Lead %	Concentrate Silver Oz.	Tailing Lead %	Tailing Silver Oz.	Recovery Lead %	Recovery Silver %	Remarks
Crushed middling through 80-mesh Callow Screen	6·0	12	5	32	—	—	7·0	3·0	46	44	
Average slime-pump	2·0	18	9	0·1	65	29	9·6	5·7	55	45	
Very finest slime	1·0	15	8	0·1	70	26	13·5	7·4	15	11	Profit per ton of pulp $1·32
Making high-grade concentrate	1·2	20	10	0·	65	29	10·4	6·8	54	45	There is over $1 more profit per ton of pulp in low concentration
Making low-grade concentrate	1·2	20	10	0·	44	20	9·3	6·2	64	56	
Reconcentration of vanner tailing	1·5	9·6	5·7	0·1	45	22	7·2	4·0	32	20	Experimental tests
Same in North Mill	2·0	9·6	5·7	0·1	40	16	6·6	3·8	37	28	Regular mill-run

throughout the mills. These vanners, built by Chalmers & Williams of Chicago, are better built than any of the other vanners tried at the Bunker Hill.

The Frue vanner has been tested in every conceivable way and the principal results can be summarized as follows:

(1) The dilution of the feed must not be greater than 1 : 20. By thickening the pulp

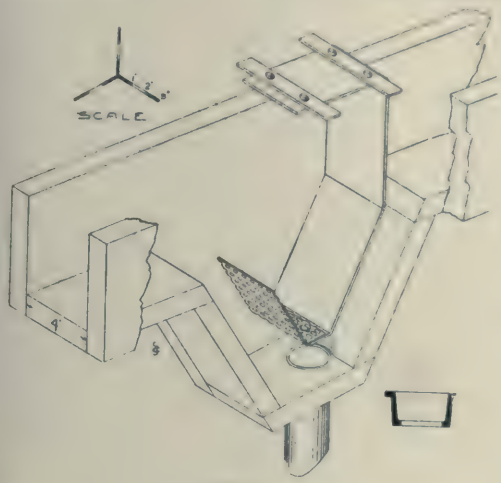


Fig. 10

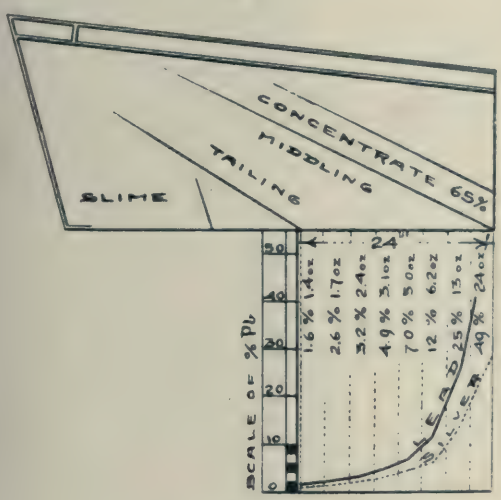


Fig. 11

to a greater extent the capacity of the vanner is raised but not its efficiency.

(2) The maximum load ought not to be over 0·6 ton per foot of belt. The efficiency of the vanner is inversely proportional to the pulp-tonnage and it is aimed to keep the load of the 6 ft. vanners at about two tons per 24 hours.

(3) The efficiency of the vanner is always low. On a rich slime it is not possible to save over 55% of the lead by one single-vanner concentration; the tailing must be thickened and re-concentrated on a second vanner that will save about 30% of the residual lead content. The extraction is inversely proportional to the fineness of the slime and not greater than 14% on the last and finest discharge of a long V tank.

(4) The efficiency of a vanner is inversely proportional to the grade of the concentrate produced. The profit, however, is not proportioned to the lead recovery, as the unit price for lead decreases rapidly with the decreasing grade of the concentrate, with the result that there is a certain maximum economical grade of the vanner-concentrate for every market-price of the metal. When the market-price is high it is profitable to make a low-grade concentrate, and the reverse.

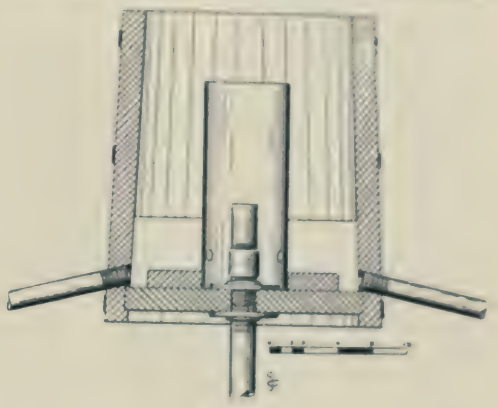


Fig. 13

The vanner pulp is thickened in double V tanks of the Old Dominion pattern, a cross-section of which is given in Fig. 12. The thickened pulp is sent to the vanners through a 4 in. pipe forming an inverted syphon and is distributed by the barrels shown in Fig. 13. This method has the advantage of a neat appearance and of giving a perfectly uniform supply of material to the vanners.

LAUNDERS: The pulp is distributed by pocket-launders, as previously described, and special care is taken to keep the launders away from the head motion of the tables to prevent possible overflows harming the mechanism. All the launder system for the products is placed below the floor and can be readily inspected. The launders throughout the mill are painted in different colours according to the products they convey, and are so marked that each product can be easily traced. Whenever possible, the switches from one launder to the other consist of pockets or depressions in the bottom of the launder, the switching being performed by opening or plugging a discharge-

opening. When the launder is lined, a removable liner is placed over the pocket and by raising this liner the product falls through the pocket into the lower launder.

For fine products, pipes are used almost exclusively; often these pipes are dropped vertically for the full available head and then run horizontally to the point of discharge. In several instances inverted syphons are used and are giving good satisfaction, even for comparatively coarse material. Steel liners are used in preference to cast liners for all launders conveying sand. They are cut out of ¼ in. mild steel bands in 4-ft. sections and are held in place by small wooden strips, which act as side liners.

GENERAL DATA: The efficiency of the mill cannot at present be determined accurately as the mechanical pulp sampler and the automatic weighing machine are not yet installed, but from the general samples taken since the plant was started it is evident that the lead recovery is above 80%. The silver recovery is always about five points lower than the lead recovery, and the loss is chiefly to be found in the iron carbonate and in the slime. The following diagram gives a fairly accurate statement of the tonnages and assays of the various products.

The mill is rope-driven by two induction motors, one for the coarse concentration and one for the table concentration department. These motors develop 354 h.p. when the mill is at full load. The ore-house, which is run only during five hours per day, requires 95 horse-power.

The mill-water is supplied chiefly by an 8 in. centrifugal pump and the average water-consumption is 2000 gal. per min. for a capacity of 575 tons, which corresponds to 3·48 gal. per ton of ore or 21 tons of water per ton of ore.

The labour is distributed in three 8-hour shifts under the direction of one foreman, and consists for each shift of 2 jig-men, 1 Huntington mill-man and 1 oiler, 1 classifier man, 1 table-man, and 1 oiler. During the daytime one roustabout attends to the general cleaning. Blacksmiths, carpenters, mechanics, shift-bosses, etc., are common to all three mills.

Before closing this article it will be useful to review the general principles followed in the design of the mechanical and metallurgical part of the mill. The chief aim was to design a mill of great mechanical simplicity and of high economical efficiency.

Previous experience had taught that the main causes of troubles, delays, and repair-expenses, are, in order of importance, trommels, bucket-elevators, transmission, and liners. To prevent these troubles, the number of trommels has been reduced to a minimum, the wet elevators are made to elevate only comparatively fine material, the transmissions have been designed at the right angle, length, and direction, and placed so as to be free from grit and water, and special care has been taken to reduce the wear of the liners to a minimum.

The mill is divided in three departments mechanically independent, and the ore progresses from one department to the other, undergoing at each step a complete treatment, so that none of the products is ever returned through the channels and over the machines through which it has already passed once. This prevents the idle circulation of products; they move rapidly through the course of treatment, with the result that the mill is very sensitive, any change in one part of the mill being immediately shown in other parts. This sensitiveness calls for more attention from those in charge, but prevents any defective operation remaining undetected and is, I believe, a most valuable feature.

All the products of one machine are generally re-treated on other machines, the function of which is to rectify the work performed by the first one. By this arrangement any faulty operation that has taken place in one part of the mill is detected and corrected in other parts. The only two products excepted are the extreme ones, that is, the highest grade concentrate and the tailing, and these are kept within a large margin of safety.

The economical side of the milling is the leading thought in the metallurgical treatment. The company has several smelter contracts, all different, and each of these offer special inducements and special charges. The main object is to divide the products in such a way that they can be sold under the most advantageous conditions. The contracts are generally based on a unit price for lead, which not only varies with the market price of the metal, but also with the grade of the product itself, and freight and treatment charges are heavy. To bring a product to a grade that will command a high price it is necessary to eliminate some of the lower-grade material with an appreciable loss of lead.

The whole problem is to determine the point at which the difference between the increased profit and the tailing-loss is at a maximum, that is, the point at which is obtained the greatest possible profit in dollars and cents for every ton of ore milled.

VALUATION OF COPPER IN CHILE

By L. C. STUCKEY

THE sale of copper ores and products in Chile is generally based upon the fortnightly quotations published by Jackson Brothers, of Valparaiso. In their report the varying rates of exchange and the sterling price of copper in Europe are reduced to a price in Chilean paper dollars for bar copper per metrical quintal on board at Valparaiso, and on this price miners sell their ores and the smelters sell to the refineries on the coast.

To English engineers the terms in common use appear strange at first and the derivation of the prices quoted is by no means clear, but in reality the method of selling is one adapted to the country and is much simpler than the complicated series of deductions and charges to which the same ores would be subject if sold in Europe. Once the bar copper quotation o.b. Valparaiso, or the price of 10% ore and the scale, is obtained from these reports, the pricing of any ore is easily done and the account rendered is readily understood by the most illiterate *barretero.* In a country where small lots of high-grade ore are often brought to the smelting works on donkey-back the conviction of the owner that he is receiving a fair price means a continuance of supply, or else, after long explanations have been given, he is firmly convinced that there is some suspicious feature, which he cannot actually identify, and so becomes dissatisfied.

Sale of Bar Copper.—The method of arriving at the copper quotation depends chiefly on the freight to Europe, the exchange, and the sterling quotation of the metal in Europe; all of which continually vary. The exact calculation used by Jackson Brothers is not public property, but an approximation thereto is as follows: Taking the sterling quotation for 99·8% at £65; this would be first reduced to a standard of 97%, which means a reduction of £1. 10s. or to £63. 10s.

The expenses in connection with the sale of the bar copper in Europe are roughly:

	£	s.	d.
Insurance, bank commission, and brokerage ⅞% or.....	0	11	1
Freight (at 40s.), landing charges, etc.....	2	6	0
Total.....	2	17	1

Deducting this from £63. 10s. we get £60. 12s. 11d.

The expenses in Chile for agency, brokerage, and sundry expenses of realization would be £0. 12s. 7d. per ton.

One long ton (or 1016 kilo.) is worth therefore (o.b. Valparaiso) £60. 0s. 4d. when the European quotation is at £65 per ton.

One metrical quintal is worth (100 kilo.) £5. 18s. 1d.

With exchange at 11d. this would be $125·81.

The Spanish quintal of 46 kilo., which is the starting point of most contracts on the Coast, is then worth $57·8726.

Homeward steamer freight for all ports *(mayores)* of Chile is the same, so that the o.b. price is applicable to any part of the Coast, while for ports north of Chile the difference of the homeward freight must be taken into consideration.

Sale of Copper Ore. — Smelters, when buying by contract, generally fix a 'base' according to the smelting qualities of the ore, the quantity that is contracted for, or the contents of precious metals known to be present, payment for these in copper ores being uncommon as compared to European usage.

Small quantities are bought on the published prices of 10% ore, the calculation for which is on similar lines to the contract ores.

The 'base' is arranged by private treaty and is entirely arbitrary; it may vary from $17 to $25, according to conditions. The 'base' may be defined as a fixed low quotation, for bar copper per Spanish quintal o.b. Valparaiso, below which copper is not expected to drop; and at this price the value of 10% ore is estimated to be, say, two dollars per metrical quintal or perhaps a few cents more. Then for every dollar that the price in Valparaiso of bar copper per Spanish quintal rises above the 'base' price, a rise of 15 cents in the price of a metric quintal of 10% ore is conceded.

The calculation would be as follows: Taking a base of $20 and the above quotation of $57·8726, the number of dollars risen above the base price is $37·8726; multiplying this by 15 cents, we get $5·6808, and adding the original base price of two dollars mentioned above we arrive at $7·68 as the price of 10% ore per metrical quintal.

The scale or unitage either rising or falling above or below the 10% is ascertained in a similiar manner. Corresponding to the base price of—say $2, as before—the scale is fixed at 30 cents per unit, more or less, and the increase of the scale for every dollar that the Valparaiso quotation rises above the base is 1·5 cents or one tenth of the rate for the 10% ores.

In the instance taken for calculation the

scale would be 56·8c. above the 30c. for the base, or 86·8 cents.

The quotations on which the smelter would settle for ores under the base and scale would be:

Ores of 10% $7·68 per metric quintal.
Scale.....86 cents

and this price would rule for one fortnight till the next report was issued.

Ores below 10% in copper are calculated with an increased downward scale, usually of 5 or 10 cents, according to the district.

The calculation of any ore-value is easily made by the prospector; for instance, a 15% ore would be worth:

$7·68 + (0·86 × 5) or $11·98 per metric quintal or $119·80 per metric ton.

Sampling, weighing, and assaying are seldom deducted, as the open prices published allow for small lots being dealt with at a profit. Should the smelting works be inland the freight to the works is often prepaid by the smelter to help the miner and deducted afterwards. If prices are quoted for ore placed at the port o.b. then the freight charges are deducted, whether the smelter is inland or not.

With blast-furnace smelting any fine ore below ¼ in. is usually subjected to a *castigo* or reduction of 50 cents per quintal, or, in some districts, if it exceeds a certain proportion to the rough, the fine is not purchased.

Copper-bearing fluxes are paid for apart from the copper content on a price per unit of available lime or iron; the practice varies with every district.

The assay used is usually the wet cyanide method without separation and a deduction of 0·3% is made to cover losses or interference of silver. Should a difference of more than three tenths of a per cent occur between the buyer and seller's assays the matter is settled by an arbitrator.

Electrolytic Zinc. — In British patent 24,631 of 1909, Edoardo Sanna, of Ingurtosu, Sardinia, describes his method of producing zinc electrolytically. The point of the invention is that he produces a coherent zinc from a spongy deposit by subjecting the sponge to a pressure while still wet. Zinc sponge if dry will not melt when heated, nor will it consolidate under pressure. The inventor takes the sponge, washes it in nitrate of soda, heats it to a temperature of 100° to 150° C, and while still wet subjects it to a pressure of 1000 kg. per square centimetre. The result of this action is to produce a zinc which will melt like distilled spelter.

The Palace Hotel, at San Francisco, is a monument to the wealth that came from the Comstock Lode in Nevada. The original Palace hotel was projected by William Ralston and finished by William Sharon, both of whom, through their connection with the Bank of California, were largely influential in developing the great silver mines of the Washoe district. Ralston in the 'sixties and early 'seventies was the head of the bank, which was then the greatest financial institution on the Pacific Coast, while Sharon was manager of the Virginia City branch at a time when the prosperity of the mines was declining and credit was hard for miners to obtain. He extended credit liberally, so that at one time the Bank of California had over $1,000,000 loaned to the Comstock companies when there was little ore in reserve and when such a sum looked much larger than it does today. Eventually the other directors of the bank became restive and in 1867 the Union Mill & Mining Co. was formed to purchase and manage the mill property held by the bank. The charter members of this organization were D. O. Mills, William Sharon, Alvinza Hayward, Thomas Sunderland, W. C. Ralston, Charles Bonner, Thomas Bell, and William E. Barrow. This was before the great bonanza orebodies were discovered, but by an active campaign of exploration the mines were put into shape, the loan from the bank repaid, and practical control of the district secured. Great wealth came to the company and to Sharon as manager. When Ralston failed in business and shortly thereafter died, Sharon succeeded him as head of the Bank of California and in other enterprises. He found the Palace hotel partly built and issued orders that it should be completed and furnished without regard to expense. When it was opened in 1875, $1,000,000 had been expended on it and it had the then unprecedented number of 850 rooms and 437 baths. It naturally became the rendezvous of mining men and in the great interior court many mines changed hands. The hotel was destroyed by fire in 1906 and for a time temporary quarters were maintained in a frame building later occupied by the Bohemian Club. The hotel covers 2½ acres of ground and includes a great court or lounge, 100 by 150 ft., somewhat after the fashion of the old building, but more beautiful. It will be seen from the accompanying illustration that no attempt has been made to erect a sky-scraper, the building having only eight storeys, and therefore is well-proportioned. The new Palace, opened on December 15, 1909, is a steel-frame

structure faced with cream brick and white granite, and covers about two and a half acres. The building and furnishing cost about $7,000,000 and the site, in the heart of the city is valued at $3,000,000. The accommodation includes 700 rooms and 670 baths. As in the past, the hotel is now the centre for mining operators, and in the grill room, court, and lobbies the traveller will meet the men active in the mineral exploration of the world.

THE PALACE HOTEL, SAN FRANCISCO.
The Monadnock and Call buildings are also shown in part.

New Guinea.—The gold rush to Lakekamu is not developing well. Miners are returning to Australia, as they find the richness of the ground is far below expectations. Those who are getting the best returns are men that have 8 or 10 boys to work for them. These have to be protected, the native tribes being hostile. On the field a mat of rice is worth 22s. 6d., beef is 1s. 6d. to 2s. per tin, so that the cost of keeping these boys is pretty heavy.

MOBILITY IN PLACER MINING

By JOHN POWER HUTCHINS

UNTIL the last year the only mechanical excavator that had been an unqualified success in placer mining was the floating dredge, which has succeeded where steam-shovels and similar machines have failed. This success is due to the mobility of the dredge.

A placer-mining machine to be successful must "keep up to its digging bank and keep away from its tailing" at such respective rates that the time lost in moving is not great enough to seriously reduce its capacity. "Keeping up to the digging bank" has generally been the easier part; it has been more difficult "to keep away from the tailing" or, to put it another way, to keep the tailing away from the machine by stacking or discharging such refuse at sufficient distance and height to prevent interference with the operations.

Let us pause to note what must be done in any placer-mining operation whether the most primitive or the most perfect. Take the miner with his gold pan, or *batea*, as an example. He excavates the material with his pick and shovels it into the pan, or, where the gravel is loose, he may scoop it into the pan without the aid of pick or shovel. He then transports the pan-full of material to a stream close-by. There he disintegrates the gravel, picking and washing out the larger pebbles, and concentrating the gold on the bottom of the pan while washing away the sand and other waste material.

The factor of mobility enters into this operation, although it is not obvious, for he can select his gravel where his judgment dictates and after washing several pans in one pool and shoaling it to such degree as to interfere with the panning, he can move to another pool and so avoid being hindered by the accumulated tailing.

Now turn to the floating dredge: The material is excavated by the chain of buckets and is transported to the screen, where it is disintegrated, the rocks and pebbles bigger than half an inch being taken out and deposited by the stacker at a height and distance sufficient to keep them clear of the stern of the dredge. The panner flipped the rocks and pebbles away with his fingers. The material under $\frac{1}{2}$ in. diam. passes over the gold-saving tables, where the greater specific gravity of the precious metal compels it to settle in the riffles, while the sand and other material is washed away and deposited behind the dredge at such distance as to keep it out of the way. The panner performs all these operations of the dredge, in a different way and at a slower rate. By the aid of dredging machinery 6 men in 24 hours can recover gold from 8,000 cubic yards of gravel whereas 6 men by panning can recover the gold from about 5 cu. yd. in the same time.

Every placer-mining operation is essentially similar to that above described. The gold-bearing material must be excavated, transported, and sorted, the gold saved and the tailing set aside. These steps of the operation can be traced through all the modifications of the rocker, long-tom, drifting, hydraulicking, and hydraulic elevating.

From the primitive operation of panning to the advanced practice of dredging a great development is apparent. Various attempts have been made to work material with different kinds of excavating, transporting, screening, sluicing, and tailing machines, in a bewildering variety of combinations, but except where a high gold tenor has existed the result has been a failure. By "high gold tenor" I mean over 50 cents per cubic yard. Operations using modified hydraulic methods in any phase of excavating, transporting, or tailing are not included in this statement.

In this connection it is interesting to note that while the working cost on the floating dredge is often less than 5 cents per cu. yd., the mechanical excavators, except those of the drag-line type, when operating in ground of similar character, show a working cost of 10 to 15 times as great. This great difference is all a matter of mobility, for while the floating dredge is extremely mobile, every other kind of placer-mining mechanical excavator is immobile to a variable degree in one or more of the phases of the excavating, transporting, screening, sluicing, or tailing operations.

Take the steam shovel as an example. This machine excavates cheaply. American steam-shovels on the Panama canal are "making the dirt fly" at the rate of about 3,000,000 cu. yd. per month. Why then has the steam-shovel failed in placer mining?

It is a fact that the steam-shovel had never been an unqualified success anywhere, if we except the operations on Shovel creek, in Alaska, where the high gold-content made it possible

THE BATEA AS USED IN SOUTH AMERICA.

GOLD MINING WITH A STEAM-SHOVEL.

to meet an operating cost of more than 50 cents per yard.

The reasons are several: First, gravel of a tenor high enough to pay the operating expense of a plant having a steam-shovel as the excavating apparatus exists in but a few regions. Second, where such gravel does exist it is often frozen and therefore impossible of excavation without first thawing at a prohibitive cost. Third, there is always an element of immobility in one of the phases of excavating, transporting, screening, sluicing, or tailing removal, so as to lower the capacity and concurrently raise the working cost to a fatal degree.

The steam-shovel is immobile because it can excavate only on a comparatively narrow face and therefore, when digging at a rapid rate, it must move frequently. Various kinds of transporting apparatus have been tried. Track systems of different types have been used to carry material from the shovel to the screening, sluicing, and tailing-removal machines either placed separately, with secondary transport between one or more of them, or in a group. The steam-shovel has been used in conjunction with a plain sluice, which served to screen and transport the gravel, and remove the tailing while men picked out the boulders.

It is neither difficult nor costly to excavate with a steam-shovel, load into cars, and transport material, nor is it difficult to screen and sluice material, but it is difficult to dispose of several thousand cubic yards of tailing daily.

Attempts have been made to do this with movable, temporary, permanent, and temporarily permanent plants, respectively, and they have all failed. If a plant should ever be installed where topographic features are such as to allow of erecting a plant on the edge of a deep gulch and so getting facilities for the disposal of the tailing even though it necessitated transporting material some miles from the shovel, it might prove successful.

It has been attempted to eliminate or lessen the difficulties of transporting material from the steam-shovel by putting the screening, sluicing, and tailing-removal mechanisms on one or more cars, which follow on a track, parallel, and near to that of the shovel. This shortens transport, for, after excavating, the shovel transports the material to the rest of the plant. This arrangement makes it necessary to move the plant either at each move of the shovel or less frequently, depending upon the radius of the shovel or some device such as a movable hopper that can be set at one of several points over a conveying belt, to lessen the frequency of moving the rest of the plant, the shovel moving ahead several times and the hopper being moved until the end of the conveyor is reached when the conveyor car is moved ahead and the hopper moved clear back to the other end of the conveyor. This arrangement has never been successful because of the lack of mobility and the difficulties of tailing-disposal, with flooding of the cut by discharging water and the accumulation of fine tailing near the plant, and for other reasons of no present interest.

The steam-shovel must work at the bottom of a cut that may need to be pumped in order to keep it clear of water; so that the rest of the plant cannot be floated on a barge. Of course, the shovel can be put on a barge and thus imitate the dipper-dredge, with all the difficulties of slow digging due to the necessary long dipper-handle and crane swinging through long vertical and horizontal arcs from the digging bank to the hopper. It is interesting to note that while 1½ cu. yd. steam shovels have dug 2000 to 3000 cu. yd. in 24 hours, the best work done by a *dipper-gold dredge with a bucket of similar size has been less than 1000 cubic yards. This difference is explained by the circumstance that the steam-shovel can dig several bucketfuls per minute with its short dipper-handle and crane while the dipper-gold dredge digging about 20 ft. below water-level can average only about one bucketful per minute. This comparison becomes still more unfavourable to the dipper-gold dredge when it is remembered that the steam-shovel often waits for cars while the dredge can work more continuously. Dipper-dredges have been discarded in gold mining.

Sintering Copper Ores. — In United States patents 951,198 and 951,199 Walter G. Perkins and M. L. Requa describe a machine for sintering copper ore. According to this invention the ore is placed in a thin layer upon a flat bed which has a perforated bottom. Underneath the bed are chambers connecting with an exhaust. Over the bed is a travelling hood containing jets which burn a mixture of gas and air. As the hood travels along back and forward over the ore, the flames are drawn through the bed. When the hood is not over the ore, air is drawn through instead of the flames. At the conclusion of the sintering operation the bed is tipped up on hinges on one side and the sintered ore discharged. The essence of the invention is the downward current of heating gases and air.

* Other dipper dredges have dug more than this.

COMPANY REPORTS

Zeehan-Montana.—This mine was floated in London in 1892 as a subsidiary of the Mount Zeehan Tasmania Silver Lead Mines, which still holds a large share interest. The property is situated on the west side of Tasmania not far from the coast. The mine did well until two years ago when the developments became disappointing. At the end of 1908, the reserve of ore was practically exhausted and the outlook was dark. The manager, John Craze, persevered and has had his opinions backed during the year by the Government geologists, who made a special examination of the Zeehan silver district with a view of determining the chances of further discoveries. The report of the company of 1909 shows that Mr. Craze has been rewarded by the discovery of several small bodies of ore and of one body which promises to develop into a valuable reserve. During the year 3435 tons of first class and 16,618 tons of concentrating ore has been raised. The shipments consisted of 2090 tons of ore and concentrate sent to Antwerp assaying 67% lead and 84 oz. of silver, and 1247 tons sold to the Tasmanian Smelting Co. averaging 60% lead and 51 oz. silver. The concentrating plant treated 9950 tons coming from No. 1 shaft assaying 9·4% lead and 11·4 oz. silver, and yielding 1079 tons of concentrate averaging 67% lead and 75 oz. silver, and 6515 tons coming from No. 2 shaft, assaying 12·4% lead and 11·4 oz. silver, and yielding 786 tons of concentrate averaging 65·8% lead and 55 oz. silver. The plant also treated a few hundred tons from No. 4 shaft and a small amount of tributers' ore. The concentration was efficient, as only 1% lead and 2¾ oz. silver was left in the tailing. The cost of crushing and concentration was just under 3s. per ton. Though the prospects at the mine have improved during the year, the directors have considered it the safest policy to try other properties, and Mr. Craze has therefore investigated the new tin district of North Dundas a few miles away. A property has been bought for the small sum of £1250; it contains three different outcrops each about 40 ft. wide and giving results 1% and upward. The development of this property will be watched with unusual interest. The company has also taken a small interest in a new silver-lead property at Dundas acquired by the Mount Zeehan company. As regards the financial position of the Zeehan-Montana, the report shows that the sale of produce brought an income of £40,081; the expenses at the mine were £40,721, the London expenses £667, and depreciation £840. There are other items in the account, but the net result of the year's work is a loss of £1725.

Ida H. Gold.—This mine is situated in the Mount Margaret district of West Australia and was introduced in London in 1900 by the North-Waddington group. The issued capital is £54,000 and dividends at the rate of 40, 40, 30, 25, and 7½% have been paid for the years 1902 to 1906 respectively. The deposit is not large and it is not easy to work, and during the past three years no distributable profit has been earned. The report for 1909 shows that the 10-stamp mill treated 14,180 tons and produced 7980 oz. bullion, and that 1210 oz. bullion was obtained by cyaniding 10,880 tons of tailing. The total output was 9189 oz. valued at £35,542. The current expenditure at the mine was £21,886, and £9929 was written off the mine-development account. The London expenses were £1454, and £1212 was allowed for depreciation. The balance of profit was £1205 which is carried to the balance sheet. Campbell Shaw, the manager, reports that the reserve is 15,470 tons averaging 13 dwt. Most of the ore comes from the 700 ft. and 800 ft. levels. To facilitate development and to increase ventilation, an underlie shaft has been sunk from the 500 to the 900 ft. level, and during its progress it has revealed additional bodies of ore. Eventually this shaft is to be carried direct to the surface and it will then be used for hauling.

Brakpan Mines.—This is one of the deep levels in the far east Rand, adjoining Apex and Modderfontein. It belongs to the Consolidated Mines Selection group and the gold deposit possesses the unusual characteristic of being situated below coal mines. W. L. Honnold is consulting engineer and C. B. Brodigan manager. The deposit has been developed by means of two vertical shafts on the dip nearly a mile apart, and connected with one another by means of an incline, the depths of the two being 3100 ft. and 3700 ft. The yearly report recently issued shows that the reserve on March 31 was 905,726 tons assaying 6·3 dwt., over stoping widths varying from 40 to 77 in. and averaging 52. Blocks totalling 428,824 tons averaging 2 dwt. have also been developed and are included in the reserve. A decision as to the metallurgical plant was postponed in order to enable the engineers to take advantage of trials of recent improvements, and the final plans were only adopted in March. The work of excavation for the foundations has been started and the orders for the machinery have been given. The battery will consist of 160 stamps weighing 2000 lb., and the buildings and bins will be made large enough for an extension of the stamps to 200. The exact coarseness of crushing is left for later decision. The initial cyanide plant will have a capacity of 60,000 tons per month. Other features of the plant will be classifying cones, air-agitation, vacuum-filters, and zinc-dust precipitation. A year ago development work was hindered by the sudden inflow of water at several levels simultaneously. A special pumping plant has been provided at No. 2, the deeper shaft, and the water will be raised in three lifts. The capacity is 1,000,000 gal. per day, and the pump-chambers are sufficiently roomy to admit of the plant being made half as large again if necessary. The balance sheet dated December 31 shows that £115,133 has been spent on No. 1 shaft and its equipment, and £166,739 on No. 2 shaft; the connecting incline has so far cost £54,568. Development has cost £52,889, and £52,560 has been spent on buildings and surface plant. On December 31, the company had £372,333 cash in hand.

Rezende.—This gold mine is situated in Penhalonga valley, Umtali, Rhodesia. It was first worked in 1892, when the United Goldfields of Manica undertook its development. The mine has not been profitable as yet, and the company has been reconstructed several times. More recently control has been acquired by the Farrar-Anglo-French group and the company was reorganized in December 1908 under the name Rezende Mines Limited. The capital then issued was 48,990 shares of £1 each, 26,600 being allotted to the shareholders in the old company, 16,645 to pay for additional property, and 5738 for cash to subscribers to the debentures of which £47,500 was subscribed for the purposes of working capital. These debentures carry 8% interest and are redeemable by ten annual drawings commencing in 1912. The report now issued covers the period from the reconstruction in December 1908 to December 31, 1909. During this period, the attention of C. R. Pinder, the manager, has been largely devoted to developments in the mine and to overhauling the plant, and the mill did not resume operations until the middle of October. A new hoist,

an air compressor, and three centrifugal pumps, all operated electrically, have been installed, and the company has also provided funds for the extension of the Penhalonga company's electric generating plant from which current is bought in addition to the current from the company's own hydro-electric plant. A sorting belt and an aerial ropeway have been erected. The ore reserve on December 31 was estimated at 52,270 tons averaging 7·7 dwt.; in addition, 72,742 tons in the old workings average 4 dwt., and 43,430 tons is partly developed. During the 67 working days in October, November, and December the 30-stamp mill crushed 9000 tons averaging 8 dwt. and produced 1823 oz. gold, an extraction of 4·05 dwt. Treatment on Wilfleys yielded 106 tons of concentrate assaying 108 dwt. gold and 89 dwt. silver per ton, which was shipped, and 145 tons assaying 18½ dwt gold, treated by cyanide. The yield from the concentrates was 575oz. In addition 4838 tons of sand assaying 2·28 dwt. and 1286 tons of slime assaying 2·2 dwt. were cyanided and yielded 436 oz. The total recovery was 2834 oz. or 6·3 dwt. per ton. The percentage of recovery was low, but the plant has not been running long and the directors hope for an improvement. The revenue was £12,099 or 26s. 10d. per ton milled, and the cost of mining and treatment was £10,074 or 22s. 6d. per ton, which includes £1800 toward redemption of the development account. During the year £11,872 was spent on development work and £6050 on sinking a new incline shaft. Operations are rendered difficult by sudden and unexpected rushes of water. Since the close of the year development work has disclosed other bodies of ore and the outlook is continually improving. It has been decided that it is best for the company to confine itself to the quartz veins and not to undertake the exploitation of the reserve of schistose ore in the old workings. These have therefore been let to tributors. Since the close of the year, Mr. Pinder has resigned to take an appointment at Johannesburg; he is succeeded by S. R. Jameson and W. E. Parker, as engineer and business manager respectively.

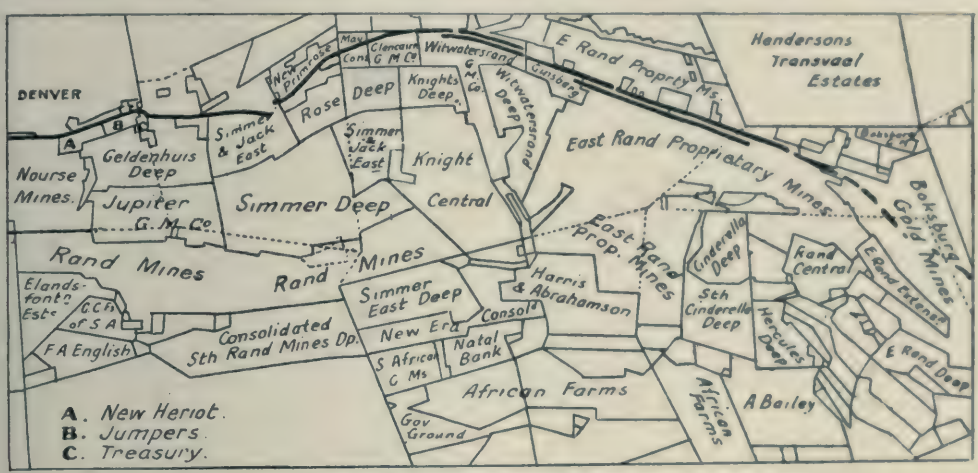
Village Main Reef.—This company was originally formed in 1888 to acquire claims on the dip of the Jubilee and City & Suburban mines in the central part of the Rand. Other properties were subsequently acquired and in 1906 the Wemmer mine was absorbed. The offices of the company are with the Consolidated Gold Fields, in Old Jewry, but the control is in the hands of the Wernher-Beit group. Milling commenced in 1892 with 10 stamps, and the equipment has gradually been increased until it now consists of 220 stamps and 4 tube-mills. The first dividend was paid in 1898 and since then a total of £1,920,743 has been distributed. The dividend for 1909 was £330,400, being at the rate of 70% on the capital £472,000. This rate compares with 55% in 1908, and 45% in 1907, and shows a state of prosperity greater than that of any other period of the history of the mine. Unfortunately the mine will become exhausted in about six years judging by the reef-area available. According to the report of the company for 1909, the reserve of ore developed on December 31 last amounted to 1,999,784 tons averaging 8·88 dwt. per ton. There are also in the mine blocks containing 886,248 tons averaging only 2·14 dwt., and the total reserve is therefore given as 2,886,532 tons averaging 6·8 dwt. This statement requires further elucidation for the benefit of both shareholders and engineers. It is not worth while treating ore averaging 2·14 dwt., but perhaps some system is available for separating it into milling-ore and waste by means of an efficient method of sorting. Of the reserve of ore averaging 8·88 dwt., 733,430 tons averaging 10·65 dwt. is in the Main Reef Leader, 802,482 tons averaging 7·82 dwt. is in the South Reef, 245,635 tons averaging 5·95 dwt. is in the Main Reef, and 178,237 tons averaging 10 dwt. is in the upper levels. The estimate of reserve is calculated on the basis of 50 in. and 57 in. as the stoping-widths in the Main Reef Leader and the South Reef, respectively. Some idea of the actual widths of the profitable veins may be obtained by examining the report of recent developments. The total distance in the drifts, winzes, rises, and cross-cuts developed during the year was 9064 ft., of which 7515 ft. was in ore. The width of the vein thus exposed in the Main Reef Leader was 12½ in. and assayed 26 dwt., and of that in the South Reef, 13½ in. assaying 21 dwt. The difference between the width of the profitable ore and of the necessary width for stoping is thus made clear to those not familiar with conditions on the Rand.

During 1909, the ore raised from the mine was 583,179 tons of which 11⅜% was removed as waste and 514,709 tons sent to the mill. The average content of the mill-ore was 7½ dwt. and that of the waste 0·4 dwt. The yield by amalgamation was 122,220 oz. or 4⅜ dwt. per ton, and the content of the tailing was 2⅜ dwt. In the cyanide plant 358,720 tons of sand averaging 3¼ dwt. yielded 48,089 oz. leaving 0·58 dwt. in the residue, and 181,735 tons of slime averaging 1⅜ dwt. yielded 11,791 oz. leaving ¼ dwt. in the residue. The total production of gold was therefore 187,201 oz. valued at £787,161 or 30s. 7d. per ton milled. The expenses were: Mining and development £243,742 or 9s. 6d. per ton, reduction £124,898 or 4s. 10d. per ton, general expenses £25,701 or 1s. per ton, total £394,341 or 15s. 4d. per ton. The extraction per ton was 5d. less than during 1908 and the cost was 1s. less. The working profit was £392,820, out of which London expenses, taxes, cost of new plant, etc., had to be deducted, leaving a divisible profit of £341,835. The company holds a large balance in hand, £147,052, intended as a fund for the redemption of capital on the approaching exhaustion of the mine.

May Consolidated.—This mine is situated in the near east of the Rand in the midst of the Barnato group, of which it used to be a member, though for the past ten years it has been under Goerz control. It is one of the smaller outcrop mines and it has been working continuously since 1887; its life will shortly draw to a close. W. M. Cameron is consulting engineer and W. Morton Webb is manager. The report for 1909 shows that 199,030 tons was raised and, after the removal of 10% by sorting, 178,845 tons averaging 7·7 dwt. went to the mill. The 100 stamps extracted 38,706 oz. gold or 4·32 dwt. per ton milled. Concentrate amounting to 12,280 tons yielded 4570 oz.; 111,170 tons of sand produced 15,578 oz., and 56,587 tons of slime gave 4343 oz. The assay-value of the sand was 3·57 dwt. and of the residue 0·8 dwt.; similar figures for the slime were 1·72 dwt. and 0·2 dwt. The total production was 63,197 oz. worth £267,872, the yield being 7·02 dwt. or 29s. 11d. per ton milled, and the percentage extraction 92%. The cost of mining and reduction was £131,464, and of development £4720, a total of £136,184, or 15s. 2d. per ton milled. In addition £10,762 was paid in taxes and £5448 was allowed for depreciation. The dividend paid absorbed £115,500, being at the rate of 40%. The cost was 6d. per ton less than in 1908, and the extraction 7d. greater, making an increase in the profit 1s. 1d. It will be noted that only a small sum has been spent in development during 1909, the reason being that this work is now practically completed. The ore reserve is estimated at 400,416 tons averaging 9 dwt. over 50

inches. Other blocks of unprofitable rock contain 138,553 tons averaging 2 dwt. over the same width. Since the commencement of operations in 1887, the gold won has been worth £3,952,516, and £1,168,093 has been distributed as dividend. In the early part of the year the unusual rainfall flooded the lower levels, and also caused the company's reservoir to burst, so flooding the Witwatersrand Deep mine belonging to the Barnato group. For the damage done thereby, May Consolidated has agreed to pay the sum of £27,000. The reservoir is not being repaired, as the price of the public supply is nowadays so cheap, being 10d. per 100 gal., that the capital expenditure on the repairs would not be warranted. In 1908 the mine suffered from an extensive collapse. The injured parts have been reopened and retimbered, but the condition still makes it desirable to keep close watch throughout the mine and timber-men are continually employed.

Geldenhuis Deep.—This company was formed in 1893 to acquire claims on the dip of the Geldenhuis companies on the central Rand and the mill commenced operations in 1895 with 100 stamps, subsequently increased to 200 stamps. In December 1909, the properties of the Jumpers Deep and Geldenhuis Estate were absorbed, and the capital was for that



A PART OF THE WITWATERSRAND.

due. The total production was 117,954 oz. or 6 dwt. per ton, valued at £495,154 or 21s. per ton milled. The cost of mining was £232,875 and of development £41,887. The expenses of reduction were £107,529. The general expenses were £31,196, bringing the total cost to £413,488, or 21s. per ton milled. The yield per ton was less by 3s. 7d. as compared with last year and the cost was 1s. 8d. greater. Consequently the profit for the year was £92,309 less than in 1908. The increased cost is due to shortage of labour and to exceptional repairs and renewals, and the decreased yield points to a general fall in the value of the reserve. The developments during the year exposed 625,888 tons averaging 4½ dwt. per ton. The reserve at December 31 amounted to 2,233,044 tons averaging 5·9 dwt. The profit and loss account shows a balance of £92,813, and as £55,633 was brought in at the commencement of the year, it has been possible to distribute £113,750 as dividend being at the rate of 35% on the issued capital.

New Goch.—This mine is in the central part of the Rand, on the outcrop, and belongs to the Albu group. Operations commenced in 1887 under the name of the George Goch Mining Co. and since then additional properties have been acquired from time to time. The

purpose increased from £300,000 to £585,753, by the issue of 235,753 to the shareholders of Jumpers Deep and 50,000 shares to shareholders in Geldenhuis Estate. The last named used to be one of the important mines but is now approaching exhaustion, practically nothing but old pillars being left. By this amalgamation the total number of stamps was increased, by the addition of 100 belonging to Jumpers Deep and 120 belonging to Geldenhuis Estate, so that the plant now consists of 420 stamps and 5 tube-mills. The company belongs to the Wernher-Beit group, G. E. Webber is consulting engineer, and H. M. Thomas is manager. Owing to the recent amalgamation, the results for 1909 are composite. The first eleven months cover the old Geldenhuis Deep, and the twelfth covers the amalgamated company. The ore mined was 460,859 tons; 68,269 tons averaging ⅓ dwt. was removed by sorting. The ore sent to the mill was 393,280 tons with an average content of 6⅓ dwt. In the battery the yield was 79,926 oz. or 4·06 dwt. per ton, leaving 2·29 dwt. in the tailing. The cyanide plant treated 394,281 tons and produced 38,028 oz., leaving 0·4 dwt. in the residue.

company was not successful until recently; the first substantial profit was made in 1908 and the first dividend was declared in 1909. The capital is £550,000 in shares and there are £227,250 debentures outstanding. The plant now consists of 120 stamps, together with tube-mills. During 1909 the amount of ore raised was 356,637 tons, of which 59,617 tons was removed as waste and 296,870 tons sent to the mill. The yield by amalgamation was 62,647 oz. or 4·22 dwt. per ton milled. The cyanide plant treated 201,211 tons of sand and 93,560 tons of slime, and produced 30,557 oz. or 2·06 dwt. per ton milled. The final content of the sand was 0·57 dwt. and of the slime 0·3 dwt. per ton treated, an average of 0·48 per ton milled. It is hoped to eventually reduce the amount left in the tailing by providing additional cyanide plant; owing to the increased duty of the stamps the time allowed for treatment in the present plant is not sufficient. The total yield was 93,204 oz. worth £394,874, and the yield per ton milled was 6·28 dwt. or 26s. 7d. The costs were as follows: Mining £127,245 or 8s. 9d. per ton milled, crushing and sorting £9674 or 8d. per ton, milling

£34,115 or 2s. 4d. per ton, cyaniding £26,846 or 1s. 10d per ton. General and office expenses absorbed £28,168 or 1s. 11d. per ton, development £16,048 or 1s. 1d. per ton, and permanent works £1014 or 0·8d. per ton, bringing up the total working cost to £243,112 or 16s 5d. per ton. The profit was £151,762, out of which £15,526 was written off the mine equipment account, £22,805 paid as interest on debentures and loans, and £11,110 appropriated for taxes. The balance brought forward from 1908 was £123,390, so it has been possible to discharge £122,750 debentures, write off £24,460 from the equipment and development account, and pay £55,000 as first dividend, at the rate of 10%, leaving £24,808 to be carried forward. Money has also been spent on capital account for the purpose of electrifying the plant. The ore reserve is calculated by the manager, E. H. Bulman, at 586,769 tons averaging 6 dwt. over a width of 44 in. ; in addition 191,595 tons average 2·9 dwt., and 93,659 tons have been blocked but not sampled. Judging by the reef area, the mine should have a life of 23 years, but owing to the uncertain contents this estimate is not conclusive.

Talisman Consolidated.—This company was formed in 1899 to acquire gold mining property near Karangahake, in the province of Auckland, New Zealand. It was reconstructed in 1904 when the Woodstock property was acquired. The capital is £300,000; dividends were first paid in 1906 when £30,000 was distributed. During succeeding years the dividends have been £60,000, £90,000, £108,750, and £120,000 showing a satisfactory progress in profits. The report for the year ended February 28 last discloses a most encouraging state of affairs due to the discovery of high-grade ore on the lowest level. Bewick, Moreing & Co. are general managers and H. Stansfield is superintendent at the mine. During the year under review the 50-stamp mill treated 44,800 tons ; the yield by amalgamation and cyaniding was 46,553 oz. gold and 234,200 oz. silver, being a return of rather over 1 oz. gold and 5 oz. silver per ton, and an extraction of 95% of the gold and 75% of the silver. At the beginning of 1910, three tube-mills were started, but defects in their construction have prevented them getting to regular work. During the last two years much new plant has been provided, among which pumps for coping with the great inflow of water take a prominent part. The cost has been provided so far out of revenue, and it is the intention of the directors to provide further funds for capital expenditure by issuing 45,000 new shares at 25s. each. The figures for the reserve on February 28 given in the engineers' report have been rendered out of date by subsequent discoveries on the 13th level. At the meeting of shareholders the chairman announced that recent discoveries had disclosed ore with average content above that of the ore treated during the past year. The orebodies are variable and their value difficult to estimate, as the figures vary from ½ oz. to 500 oz., the latter figure being given together with suitable advice. The mine appears to have several prosperous years before it.

New Einasleigh.—This company was formed in 1907 to operate a copper property in the Chillagoe district, North Queensland. The control is with the same group as British Broken Hill. Alexander Stewart and W. H. Woodhead are on the board, and H. G. V. Adler is manager. Operations have so far been confined to development. The report for the year ended January 31 shows that a valuable orebody has been proved. The work during the year has been devoted to opening up the 3rd and 4th levels. At the 3rd level a cross-cut was driven, and met the lode at 254 ft. The lode was here found to be 47½ ft. wide averaging 8% copper. A drift to the north passed through 88 ft. of ore and then came into faulted country. Subsequently the lode was found again and as driving was continued the content gradually increased to 8½%. By diamond drilling at the end of the working it was shown that the lode was 61 ft. thick averaging 6% copper. A south drift on this level was carried 75 ft. through 6½% ore and at a point 30 ft. from the cross-cut a winze was sunk 90 ft. in ore of the same grade. On the 4th level the lode was intersected at 324 ft. from the shaft and was found to be 30 ft. wide averaging 9%. A north drift passed through 30 ft. of 8% ore and a south drift after passing through broken country joined the lode and for 37 ft. exposed ore averaging 7% copper. The manager estimated that the ore reserve on January 31 was 141,500 tons, half of it averaging 8% and half 4%. A cable read at the meeting in June announced that since the end of the year covered by the report additional ore estimated at 77,000 tons had been developed, bringing the total reserve to 233,500 tons. In order to test the smelting quantities of the ore, 15,000 tons was sold to the Chillagoe company ; about half of this was delivered during the year under review and the remainder since. By this sale the development expenses have been met. A concentrating plant capable of treating 150 tons per day has been built. This includes a unit of Elmore vacuum-plant and Wilfley tables, which are to be tried against each other on the fine portions of the ore. The directors say that the cost of treatment of the former will be greater than that of the latter, but at the same time the recovery will be higher.

Temiskaming.—This company, working in the Cobalt district of Canada, was formed in April, 1906, and dividends commenced in March, 1908. The report for the year ended January 31 last shows that during that time 27,780 tons was raised, of which 18,260 tons was ore and 9520 tons waste. The amount of ore treated by picking was 15,891 tons and the yield was 240 tons of high-grade, 397 tons of second-grade, and 156 tons of low-grade. The amount sold to smelters was as follows: 239 tons of high-grade averaging 2450 oz. silver, 384 tons of second-grade averaging 198 oz., and 156 tons of low-grade averaging 48 oz. The gross value of the silver content was $348,903. After deducting cost of treatment, freight, allowances, etc., the net receipts were $308,113. During the year 17,466 tons averaging 28 oz. silver was thrown on the dump awaiting future treatment. The cost of mining was $155,628, of crushing and sorting $10,357, smelting $23,387, general charges $40,344, and there were other small items, leaving a net profit of $76,805. The year started with a balance in hand of $89,125, and $150,000 has been distributed as dividend which is at the rate of 6% on the capital $2,500,000. Additional expenditure on the new concentrator, $132,156, has been charged to capital account. During the year under review the new main shaft has been carried down to 420 ft. and is thus the deepest at Cobalt. At this depth the prospects of opening up a wide vein of milling ore are excellent. At one or two of the upper parts the developments have not disclosed the same proportion of high-grade ore as was found nearer the surface and the output has suffered in consequence. On the other hand, the veins appear to be wider, and the amount ready for treatment by the new mill is large. Norman R. Fisher, the manager, estimates the reserve at 220 tons of high-grade containing 3000 oz. per ton ; of milling ore he estimates 40,000 tons, containing 30 oz. per ton, in the mine, and 34,000 tons on the dump, averaging 45 oz. The new concentrator was built during the year and it would have been at work now had the electric supply company been ready with the necessary power.

The ore is broken to pass a ¾ in. aperture and is then classified into jig and table products. Three Richards' pulsator jigs treat the ore down to 14-mesh and the finer goes to James tables and a slime-plant. The tailing from the jigs goes to six stamps weighing 1250 lb. each, the product from which is classified, the sand going to James tables and the fine to slime-tables. The capacity of the mill is 100 tons per day; by increasing the number of stamps treating the jig tailing the capacity might be greatly increased, as the jigs themselves could handle 250 tons per day.

Butters Salvador.—This company was formed in 1899 to acquire gold mines developed by Charles Butters in the Santa Rosa district, Republic of Salvador, Central America, 40 miles from the port of La Union. Two orebodies have been worked, the San Sebastian and San Miguel; these are probably connected and development work is being undertaken with a view to exploring the ground between them. Mining is done by adit, and the main level is 600 ft. below

Part of Central America.

the highest point of the outcrop. The capital is £150,000 and dividends were first paid in 1903, when 5% was distributed for the year ended June 30, 1903. Succeeding yearly dividends have been at the rates of 55, 40, 55, 75, 80, and 68¾%. The report for the year ended June 30, 1909, was presented at a meeting of shareholders held on May 20, 1910, the delay being due to the absence of directors from London. The ore treated during the year was 21,664 tons and the yield was 38,504 oz. The sale of bullion during the year under review realized £151,520. Mining, milling, and cyaniding cost £55,037, depreciation £3590, mine development £15,532, and London, New York, and San Francisco expenses £7705. The divisible profit was £68,129, and with £54,038 brought in from the previous year the available balance was £122,167. Out of this £103,125 has been distributed to shareholders, the rate being 68¾%. The most recent cables issued a few weeks ago showed that developments have greatly added to the reserve, which now amounts to about 100,000 tons averaging 33 dwt. per ton.

St. John Del Rey—This company, operating the Morro Velho gold mine in Minas Geraes, Brazil, was formed originally in 1830. We gave a summary of the interim half-yearly report in our December issue and traced the history of the company. The report now issued covers the year ended February 28. During this period 185,837 tons of ore was raised and, after sorting out 2·6%, 181,000 tons was sent to the battery of 120 stamps. The yield in the stamps and by the succeeding 'oxygen' process was 104,003 oz. or 45s. 9d. per ton, the total realizing £416,330. From the Cuiaba mine gold valued at £21,783 was recovered. The working cost was £277,161, development £14,702, taxes, etc., £20,490, and London expenses £3899, leaving a profit of £121,861. Out of this £55,849 was allocated to expenditure on new works in connection with electric power, £5458 was paid as interest on debentures, and £10,583 as dividend on the preference shares. The distribution on the ordinary shares was £48,177. These amounts paid to debenture and shareholders include English income tax; after deducting the tax the rates of interest dividend are 7%, 10%, and 8⅓% respectively. The directors are now proposing to create £100,000 in second preference shares carrying 10% dividend in order to provide the necessary funds for discharging the debentures, of which £31,475 fall due in 1911 and £36,275 in 1913. Though these are created it is not likely that many will be issued, as most of the debentures are to be renewed. It is noteworthy that the amount of ore treated annually is gradually increasing, a fact due largely to the efficiency of the new electric haulage system. The tube-mills recently installed have improved the extraction by the 'oxygen' process, but they are found to consume much power, an expensive item at St. John Del Rey. The question of the life of the pebbles used for grinding is an interesting one. Imported flints and local silicified iron carbonate have been used. The former last five times as long as the latter, but the relative prices delivered are £9 and 17s. 6d. The pyritic concentrate to be ground is twice the specific gravity of the pebble, whereas the iron carbonate is practically of the same specific gravity as the concentrate. The grinding efficiency of the latter is therefore much greater. The iron carbonate has also the advantage of containing a small amount of gold, most of which is recoverable.

Pena Copper.—This mine in the south of Spain has been worked by an English company since 1900, having previously been owned in Belgium. The Siemens group own large interests in the company, and Nicol Brown is chairman. Harvey & Wilbraham are the consulting engineers. Much time and trouble have been taken to re-organize finances and methods. The capital is now £600,000 and £53,600 debentures are outstanding. Dividends of 5, 5, 4, and 7½% were paid for the years 1903 to 1906, but nothing has been distributed since. The report for 1909 shows that mining operations were suspended from April to August and the full force put on the removal of overburden. Consequently the overburden removed was greater than in 1908, the figures being 185,435 and 145,952 cubic metres, while the amount of pyrite extracted was only 130,784 tons compared with 190,917 tons in 1908. The operations have also been hindered by scarcity of water owing to the scanty rainfall. The ore added to the

heaps for leaching was 81,116 tons compared with 169,345 tons the year before. The copper precipitate produced contained 1053 tons of metal as compared with 1177 tons in 1908. The shipments consisted of 6390 tons of copper ore, and 29,675 tons of sulphur ore, direct from the mine, together with 79,494 tons of washed ore from the heaps. The receipts and costs are not given. The balance of profit was £32,561, out of which £7262 went as London expenses and taxes, and £2680 as debenture interest. Debentures to the amount of £10,400 were redeemed and the balance £12,228 was carried forward, making the total balance in hand £29,792. This balance has already been devoted to overburden account, to providing new power-plant, and to further development work.

San Miguel Copper.—This pyrite mine in the south of Spain has been under the same control as the Pena for the past three years. The report for the year 1909 shows that 78,849 tons of pyrite was extracted, of which 70,498 tons was sent to the leaching floors and the remainder exported. The production of precipitate was equal to 642 tons of fine copper, and the export of washed ore was 36,915 tons. All these figures show an increase over those of 1908. The mine is now well equipped with plant and no further special expenditure will be necessary. After providing for depreciation, the net profit for the year was £5733, of which £1477 has been devoted to the extinction of the mine development account, and £240 added to the reserve, which now stands at £50,000. The company was in a bad state when the present directors acquired control and the finances and mining methods had to be severely re-organized. It has therefore been impossible to declare any dividends recently.

Palmarejo & Mexican.—This is a company with a 'past,' but also we believe with a future. It is 25 years since the properties, which are situated in Chihuahua, Mexico, were floated in London. For a long time reckless mismanagement squandered large amounts of capital. Later, after the incapable directors and engineers were removed, several men of position made attempts to improve the methods of mining and metallurgy. It was found that the orebodies were irregular though extensive and the content low, averaging 2 dwt. gold and 15 oz. silver. It was found that the ore was of too low a grade for amalgamation and would not give good results by any cyanide process known at the time. Eventually, two years ago, E. T. McCarthy's advice was taken and he reported that the process now in use in Nevada and in other parts of Mexico would be applicable to Palmarejo ore. He examined the mine and indicated the best lines for exploration and development. The report for the year ended June 30, 1909, was presented at a meeting of shareholders held on June 14 of this year, when the chairman, John Perry, who had returned from the property, gave the latest information. The development work was then reported to have exposed 140,000 tons of ore averaging 2·4 dwt. gold and 14½ oz. silver and that at several points the orebodies gave indication of further reserves. It is intended to continue developments for a few months longer and then to erect a new metallurgical plant. In the meantime the old plant has been cleared and the foundations prepared for the new; and plans have been adopted for an aerial ropeway to connect the mine and mill. Mr. McCarthy, at the meeting, showed that a greater quantity of ore had been found per foot of development than he had originally anticipated, and that consequently the 5665ft. had cost only 2s. per ton of ore developed. Taking the content at 38s., Mr. McCarthy expected that the profit would be 18 to 20s. per ton. More money has been and will be required, so the capital of the company has been rearranged. A third series of debentures for £30,000 was issued recently in order to provide funds, thus making the total debentures £80,000. By a resolution passed at the meeting the nominal capital was reduced from £875,000 to £350,000 by the cancellation of 15s. on each of the 700,000 shares of £1 each. The shares consisted of 700,000 of £1 each and 700,000 of 5s. each, all ranking equally for dividend; the 5s. shares were issued in 1909 on these favourable terms, as a substitute for reconstruction. Of these two classes of shares 679,063 of the £1 shares were issued; the whole of the 5s. were issued and 2s. 6d. called up. The subscribers to the 3rd debentures have the option of taking any unissued or unsubscribed shares in exchange for the debentures.

Great Boulder Proprietary.—This mine undoubtedly deserves to be called the premier mine of Western Australia; during the 15 years of its life it has produced gold worth more than 6½ million pounds. G. P. Doolette is chairman of directors and Richard Hamilton is manager. The report for 1909 shows that 187,755 tons of sulpho-telluride ore was treated in the stamp-mill, yielding by amalgamation bullion valued at £227,317, and by cyanidation bullion valued at £366,366, a total of £593,683. The costs were as follows: Development, £38,329 (amount developed 207,406 tons, a rate of 3s. 8d. per ton); mining, £82,143 or 8s. 9d. per ton of ore mined; milling and roasting, £83,783 or 8s. 11d. per ton; cyanidation, £32,955 or 3s. 6d. per ton; general charges and sundries, £12,776; bringing the total cost to £248,382 or 26s. per ton. These tons are of 2240 lb., therefore the working cost per 2000 lb. is 23s. Office expenses in London and Adelaide absorbed £10,010, taxes £29,100, depreciation £45,000, and £262,500 has been distributed as dividend. The ore reserve on December 31 was 751,077 tons averaging 16 dwt. which is 1 dwt. more than the content of the ore treated during 1909. The Main shaft is now down 2599 ft. and the Edwards 2557 ft. and they have been connected at the 2350 ft. level. The richest part of the ore now being developed is in the 2200 ft. level, the average being 25 dwt., and the ore on the 2350 ft. level is as good as any found in the 1000 ft. above with the exception of this rich ground. The two most important developments on the 2500 ft. level are blocks 51 ft. long of 12 dwt. ore 5 ft. thick and 54 ft. of 13 dwt. ore 5 ft. wide in the north and south drifts from Edwards shaft. This is a better result than in the ground between the 1600 to 2050 ft. levels, where the average has been only 11 dwt. The amount of ore in hand is sufficient to last for 4 years and the prospects for further discoveries seem to be good.

Selukwe.—The statutory meeting of the reconstructed Selukwe Gold Mining Co., operating in Rhodesia, was held on June 24. It will be remembered that last autumn the mine showed signs of exhaustion. The Chartered company and the Bechuanaland Exploration Co. came forward and guaranteed the issue of new shares for the purpose of raising further capital wherewith to continue prospecting and development work. At the same time A. H. Ackermann, the Chartered company's engineer, proceeded to the mine to direct operations. With the notice convening the statutory meeting there was circulated a report by Mr. Ackermann dated May 21 stating that development work had not revealed any profitable orebody, but a more recent cable dated June 20 was also published announcing that 80 ft. driven on the 10th level of the Nigger Reef property had assayed 8½ dwt. over a stoping width of 4½ ft. This discovery makes the outlook more encouraging.

PRÉCIS OF TECHNOLOGY

Glass Mine-Models.—In a contribution to the discussion on E. D. North's paper on the model of the Montana-Tonapah mine workings published in the January *Bulletin* of the American Institute of Mining Engineers, A. Scott Reid, a member of the London staff of the Waihi Gold Mining Co., describes the model he has made of the Waihi mine. The model is contained in a dust-proof glass case of which the top, bottom, front, and two sides are of glass and the back of wood painted dull white to show the workings distinctly. The plane of each level is represented by a horizontal sheet of glass supported on metal runners which are fixed to the uprights at each end of the case. The corner uprights are strengthened with metal so as to provide support for the additional sheets of glass required as each succeeding level is commenced. The sheets measure 40 by 20 in. and are ¼ in. thick. Only the front of the model is removable. The workings are traced on the glass with ordinary oil colours. All the drifts and cross-cuts are drawn in black, and the veins are painted in crimson, the walls being indicated by a thin vermilion line. The width of the veins is indicated by vermilion figures at the ends of the cross-cuts and elsewhere. All figures and notes referring to the veins are done in vermilion and those relating to levels, depths, names of cross-cuts, etc., in black. Other colours are used to indicate geological features. Thin sheets of gelatine are used instead of glass to represent the veins. They are easily bent to follow turns and are held in position against the glass levels at top and bottom by means of angle-pieces of the same material. If the strips are bent to the right position while held in a moderate heat they will retain the position on cooling. The winzes and stopes are shown on these gelatine strips. As stoping proceeds the strips are coloured crimson to correspond. The thickness of a vein is indicated by sticking pieces of gelatine transversely to the strike and painting the cross-section on them. Winzes are shown by broad black lines drawn on the strips, and where these are sunk in ore a narrow line of crimson is drawn down each side. The contour of the surface is shown by vertical strips of gelatine radiating from a point where the altitude of the surface is highest, the top edges of the strips being cut to represent the vertical section of the country. The bottom of the model is of glass, but a sheet of thin opaque tracing paper is stretched over it to diffuse the light from electric lamps underneath. These lamps can be moved about so that the light may be either diffused equally or concentrated on some particular part. The scale of the model is 50 ft. per inch.

Geology of Kalgoorlie.—C. G. Gibson, of the Geological Survey of West Australia, has written articles on the geology of Kalgoorlie for publication in the forthcoming book 'West Australian Mining Practice,' which is to be published shortly by the Chamber of Mines of Western Australia. Mr. Gibson's articles have been published preliminarily in the March and April issues of the *Monthly Journal* of the Chamber. The chief topographical feature of the Kalgoorlie goldfield is a central ridge trending north-northwest, and reaching its maximum altitude in Maritana Hill or Mt. Gledden, which rises to a height of 150 ft. This ridge is four miles long and its southern end is just beyond the Boulder group of mines. On each side of the ridge are valleys, or rather flats, that on the eastern side being 5 miles wide, and that on the western 3 miles wide. On the farther side of the eastern flat is a more conspicuous range of hills running northwest with a maximum height of 200 ft. The western flat is flanked with a low range, better defined at the southern than the northern end. Both flats drain southward into Hannan's lake, which is an extensive salt marsh commencing a short distance south of the Boulder mines. On the western side of this marsh is a small but prominent group of hills, the highest point of which, Mt. Hunt, rises to 400 ft. Kalgoorlie is situated on the western slope of the central ridge just to the north of its middle point.

The original rocks of the Kalgoorlie district were of sedimentary origin, and consist of shale, soft sandstone, grit, conglomerate, etc. They were deposited probably in pre-Cambrian time on a gneissic or granite floor, and were afterward tilted into their present highly inclined positions. Later followed the intrusion of large masses of basic igneous rocks (amphibolite, quartz-diabase, porphyrite, peridotite, etc.), these in turn being intruded by a smaller series of acidic rocks (quartz and felspar porphyries). Further earth movements then took place, causing shearing and faulting of the rocks, the shearing resulting in the formation of the lines along which the gold-bearing lodes are found.

The rocks may be grouped under the following heads: (1) ancient sediments (shale, sandstone, grit, conglomerate, etc.); (2) calc-schist; (3) fine grained amphibolite (representing the older greenstone); (4) quartz-diabase); (5) coarse-grained amphibolite (later or intrusive greenstone); (6) peridotite (probably intrusive); (7) porphyrite; (8) quartz and felspar porphyries (newer intrusives); (9) recent deposits (sand, loam, laterite).

The ancient sediments consist of soft sandstone, shale, mica and talc schists, grit, and conglomerate. They are all practically non-auriferous. They are found on both sides of the main complex of igneous rocks, the belt on the western side being of much greater interest. This belt starts 4 miles west of Kalgoorlie and has a width of 10 or 12 miles, its general trend being north-northwest; how far northerly it extends is not known, as everything is hidden by a covering of loose sand and loam. The rocks of this series are mostly soft banded-sandstones; they have a prevailing strike of 25° west of north and dip steeply to the west. The most interesting feature is the occurrence of a well-defined series of coarse conglomerates interbedded in the sandstone and grit. These have their greatest development at a point 8½ miles southwest of Kalgoorlie, where they form a well-marked ridge trending north-northwest for several miles. At least three main bands of conglomerate exist; with the intervening bands of soft sandstone they have a maximum thickness of over 1000 ft. They are steeply inclined, and dip at an angle of from 75° to 80° westward. The matrix is a fairly soft, slightly micaceous sandstone, practically identical with the surrounding rock, while the pebbles, which are rarely more than 6 in. diam., consist of banded and jasperoid quartz, black cherty quartz, hard white quartz, quartzite, quartz and felspar porphyry, felsite, and granite. The pebbles are set closely together in the matrix and are water-worn and rounded. Since their deposition they, together with the enclosing beds, have been subjected to pressure and shearing, and usually split readily in one direction; were it not for this defect they would be suitable for use in tube-mills. On the eastern side of the main ridge is a second series of sedimentary rocks having a width of 3 or 4 miles and an undetermined length. Their strike is about 30° west of north and they dip steeply west; they consist mostly of shale, soft sandstone, and grit. A third series of sedimentary rocks is found on the eastern side of the eastern range of hills, similar in character to those of the western series. The conglomerates of this series differ from those of the western in that they are of much less extent and not so well defined; they are also more weathered.

Calc-schist forms the eastern portion of the main auriferous series and, next to the quartz-diabase, is the most important rock in the district. This schist is fine-grained, but varies in colour and general appearance; typically it is dark gray on fresh fracture with a somewhat blotchy appearance, characterized by numerous minute veins of calcite; it breaks readily in almost any direction and frequently shows scaly chlorite along the cleavage planes. A less typical form is darker, finer grained, more compact, harder, and does not exhibit the same amount of schistosity; it is merely a less sheared and less altered form and differs but little, in hand specimens, from the finer-grained chloritic diabases. These rocks were probably a basic lava flow, interbedded with the sedimentary series. Their original structure has been almost obliterated, and they now consist of an indefinite mixture of chlorite and carbonates, with only occasional traces of their original crystalline form. Owing to the obliteration of crystalline structure the original toughness has been lost and the rocks fracture readily. Thus, mining operations are easy; moreover, owing to the less frequent occurrence of joint planes the rock stands better than the quartz-diabase and amphibolite. This formation ranks next to the quartz-diabase in its interest to the miner.

The fine-grained amphibolites are found on the western side of the northern portion of the coarse-grained amphibolites and on the eastern side of the calc-schist belt. In places they resemble the calc-schist series and also probably belong to an older series of greenstone, being possibly a closely related lava-flow. They are dark green, mostly massive, and very fine-grained; they consist of light-green hornblende and chlorite with occasionally small crystals of felspar A microscopic examination shows also the presence of calcite, epidote, and various iron compounds.

The quartz-diabases are the most important as they contain the principal orebodies. The typical rock is massive and coarse-grained. It is dark green with patches of white consisting of porphyry-felspar and quartz. Under the microscope the rock is seen to consist of plagioclase, quartz, and chlorite; the felspar and quartz show micro-pegmatitic structure and the chlorite probably is derived from original augite. In addition ilmenite, calcite, apatite, and saussurite are present. Another variety of the rock is finer grained, with less felspar and quartz discernible by the eye. Both types have undergone great changes and show varying degrees of foliation, schistosity, and chemical alteration. They often show close resemblance to the coarse amphibolites and probably were derived from the same magma. An interesting form of extreme alteration is found in the 'graphitic slate' bands, which are of common occurrence. Usually from 2 to 6 ft. thick, in some cases they are as thick as 100 ft. They are occasionally persistent in depth and sometimes have gone down 2000 ft. The author considers them to be highly-sheared bands, the graphite being deposited subsequently to the shearing, and formed by the decomposition of hydrocarbons derived from deep-seated sources. Being sometimes associated with the orebodies, these bands cause trouble to the millman. In some places, near the surface, the bands contain no graphite. A second interesting modification of the diabases is the alteration to carbonates of lime, iron, and magnesium. The rock then is soft and has a white and pink colour, and sometimes, when sericite is present along the cleavage planes, has a greasy feel and is called 'fish-rock.' Good examples of this carbonated diabase are found in the deep workings of the chief mines.

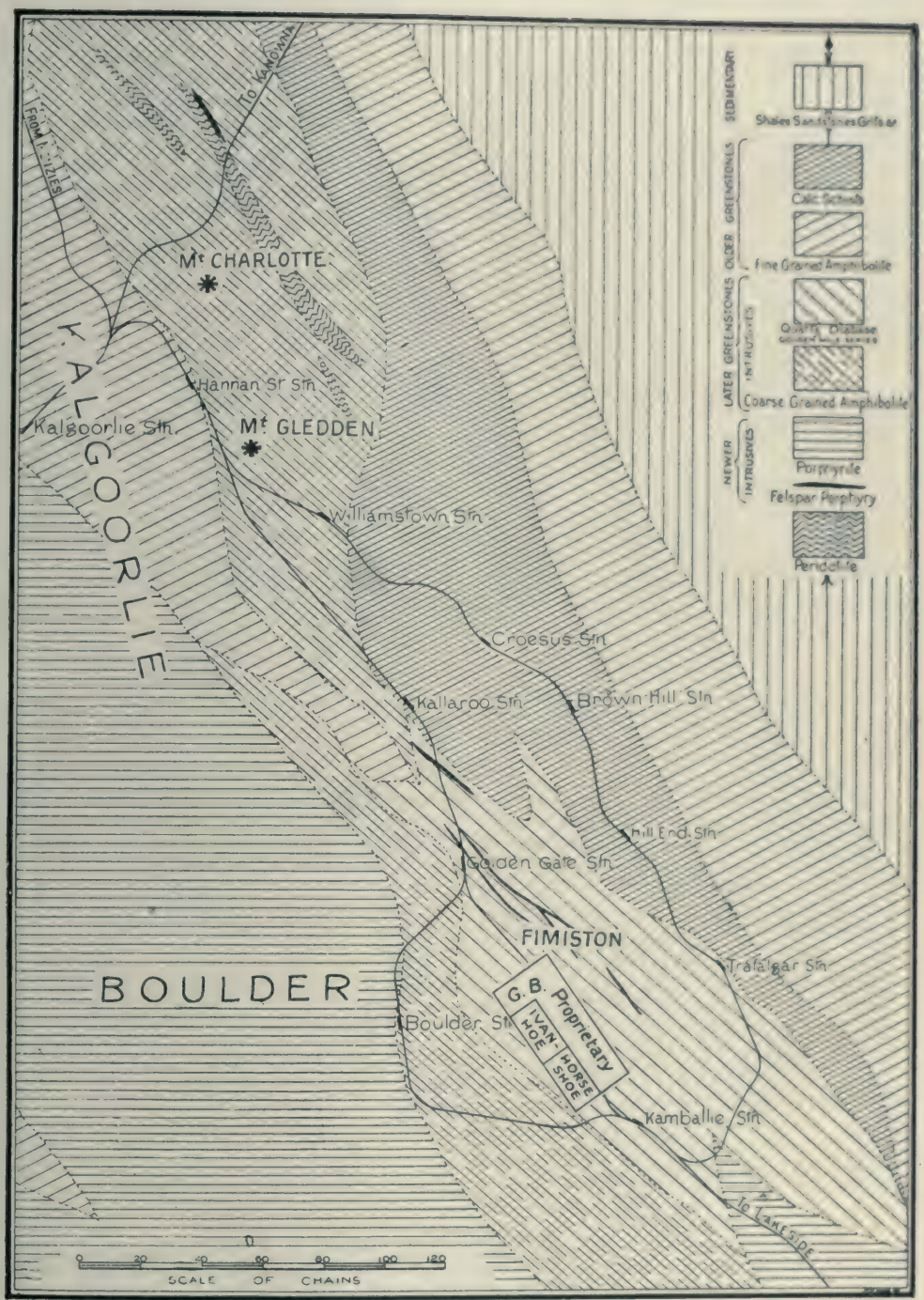
The coarse-grained amphibolites are divided into basic and acid types, the latter being a variation found along the western side of the northern area. The basic type is dark green, consisting of green hornblende and chlorite, while the acid is mottled with felspar. Both types are massive and have not been subjected to the same amount of shearing and alteration as the diabase. In value to the miner they rank after the calc-schist, but it is only at the north end that they contain any profitable deposit.

Peridotite is found chiefly in the south, near Hannan's lake. This rock is fine-grained, usually almost black, with a conchoidal fracture; it is sometimes altered into serpentine and sometimes changed by carbonation. Asbestos and magnesite are found as variations. At the northern end chrome-mica is associated with the peridotite, which is practically non-auriferous.

The porphyrite underlies the recent deposits on the western flats. It is a massive rock usually of brownish green or dark brown, with white spots of felspar. The quartz and felspar porphyries are found chiefly as narrow dikes older than the auriferous lodes; they are not numerous and are of no great importance. The recent deposits consist of loose sand, loam, ironstone-gravel, laterite, etc., produced by the weathering of the underlying rocks. They cover the greater part of the district, and at some places render difficult the accurate mapping of the geology. The author considers that the laterite has been formed in place through the gradual concentration, by atmospheric agencies, of the ferric oxide derived from the decomposition of the rocks.

Nitrogen.—*Metallurgical & Chemical Engineering* for June contains an article reviewing the processes in use for making nitrogenous compounds from the air. Two processes are now at work in Europe whereby the oxygen and nitrogen are caused to combine by exposing air to a high temperature by means of electric discharges. One process was invented by Birkeland & Eyde and is in operation in Norway, the other was invented by Schœnherr and is worked by the Badische Anilin und Soda Fabrik in Germany. The processes are not easy, as the nitrous oxides formed are diluted with much air, and their transformation into nitric acid or nitrates is complicated; also the consumption of electric power is high. A third process for utilizing nitrogen is the manufacture of calcium cyanamide. Here the nitrogen has to be separated from the oxygen by the fractional distillation of liquid air, and it is then brought into contact with calcium carbide at a high temperature. Cyanamide can be used as a fertilizer and as a raw material for the manufacture of other chemicals such as cyanides. The power consumption is not as great as that of making nitric acid, but is still high. Details of a third process have recently been published showing that ammonia can be made from nitrogen and hydrogen by their exposure to the catalytic action of osmium or uranium at a temperature of 500° C and under a pressure of 200 atmospheres. The process has been invented by F. Haber and R. Le Rossignol, of Karlsruhe, and it is being developed by the Badische company. So high an atmospheric pressure is a novelty in practical chemistry, though there is no reason why it should be a disadvantage. It will be noted that the temperature at which the reaction is conducted is not particularly high, and probably much less power will be required than in the other reactions. The future of the process will be watched with interest.

Treating Cobalt Ores.— At the meeting of the American Electro-chemical Society held in May, Camillo C. Cito, of the Irvington Smelting & Refining Works, New Jersey, read a paper describing his process for treating ores from Cobalt, containing silver, nickel, cobalt, and arsenic. This paper is published in the June issue of *Metallurgical and Chemical Engineering*. Mr. Cito's



GEOLOGICAL MAP OF THE KALGOORLIE DISTRICT.

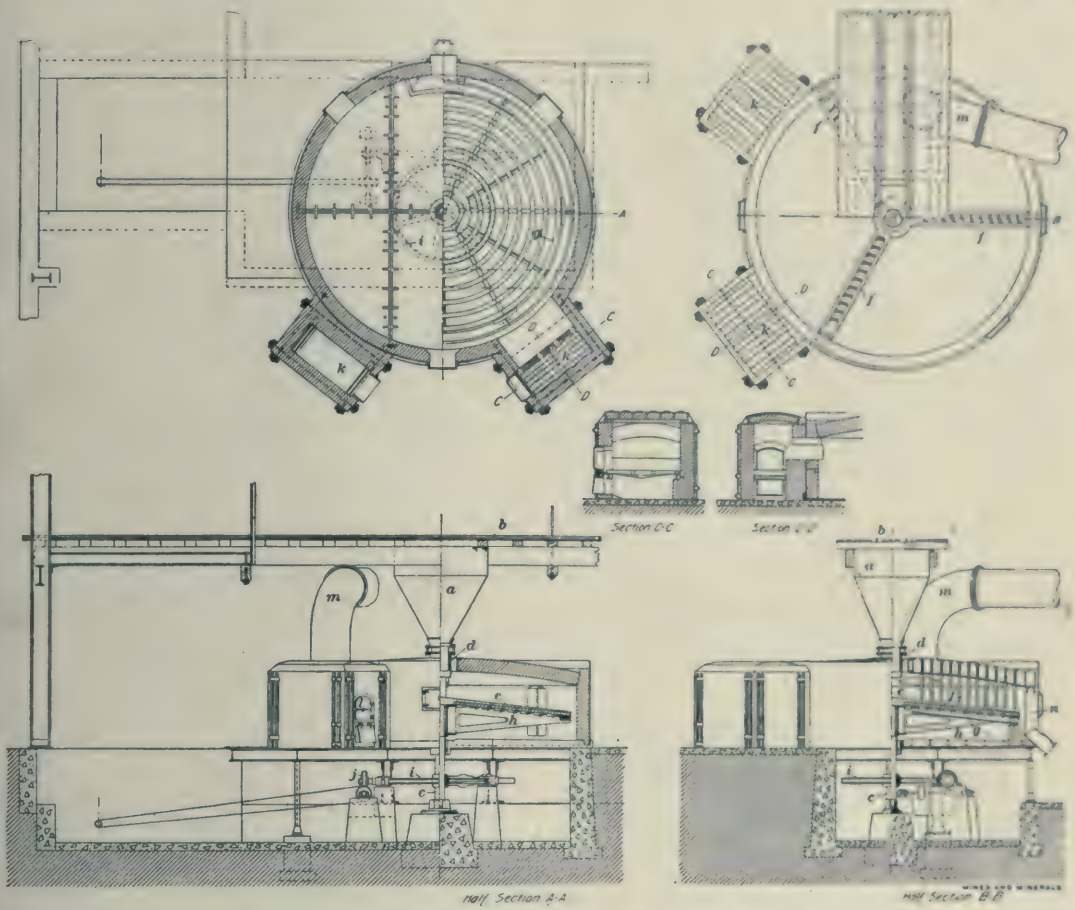
object is to treat the ore without volatilizing the arsenic, thereby preventing both danger and loss of silver. He adds copper and treats the mixture in a reverberatory. The arsenic is absorbed by the copper and is not volatilized. The product consists of an alloy containing the copper, silver, nickel, cobalt, and arsenic. The slag produced contains a small amount of silver, nickel, and cobalt, but practically no arsenic. The amount of copper added to the charge is regulated so as to produce certain proportions of the metals in the alloy suitable for subsequent refining by electrolysis. The proportion of copper should be two-thirds that of the nickel-plus-cobalt, at least as much as that of the arsenic, and preferably not less than the silver. A specimen charge quoted in the paper consisted of 174 lb. of ore containing 6200 oz. silver, 12½% arsenic, 31% nickel-plus-cobalt, 3½% iron, 1% sulphur, and 9·6% insoluble. To this 23 lb. copper and 55 lb. flux were added. The alloy produced amounted to 195 lb. and assayed 5500 oz. silver, 10¾% arsenic, 27½% nickel-plus-cobalt, 19½% copper, ½% iron, 1·2% sulphur; 56 lb. of slag was made and it assayed 20 oz. silver, ½% nickel-plus-cobalt, 7½% iron, ½% copper, and only a trace of arsenic. The alloy is cast direct into anodes and sent to an electrolytic bath. The electrolyte is sulphate of copper containing 10 grammes of copper and 5 grammes of free sulphuric acid per litre. The cathodes are of pure copper. The copper in the anode is deposited on the cathode, the silver is precipitated as slime, the nickel and cobalt go into solution, and the arsenic goes chiefly into solution though some is precipitated with the silver. When the electrolyte contains 55 grammes of nickel-plus-cobalt and 30 gm. arsenic per litre it is sent to another bath for the recovery of its contents. Most of the copper is here deposited on lead cathodes, and the remainder precipitated with sulphuretted hydrogen while the solution is cold. On heating the solution, sulphuretted hydrogen precipitates the arsenic as sulphide, and subsequently the nickel and cobalt are saved in any usual way.

The Quicksilver Situation.—The *Mining and Scientific Press* for May 28 contains an interesting review of the present position of quicksilver. The consumption for metallurgical purposes is far smaller than it used to be, but the price is maintained. The control of the market is in London, with the Rothschilds, who hold extensive stocks. Prices have fluctuated during recent months to a greater degree than usual, but the business is so hedged with secrecy that the most acute observer of production cannot make even a guess at the stocks held nor explain the movements in price. It is supposed that the recent rise in price was due to large orders from Russia and Germany commencing in December 1909. For four months shipments to these countries were approximately 1500 and 1000 flasks per month respectively. Obviously these supplies were required for the manufacture of fulminate detonators, This use for mercury comes next in importance to amalgamation, and it is followed by mirror-plating, barometers, thermometers and other scientific instruments, and pigments. At one time large shipments were sent from California to China for conversion into vermilion, but this trade has now ceased.

The circumstances connected with the production and consumption of quicksilver have greatly changed during the last 20 years. In early days the Californian ores were rich; in some cases they ran 20%, and 3 to 4% ores were common. Nowadays an ore averaging ¾% is considered comparatively high-grade and one of the chief producers works on ½% ore. As regards consumption the hydraulic miners in the old days were wasteful and much went into the tailing piles. The ordinary stamp-mill loses 20% or more; pan-amalgamation was extravagant, and much loss was due to 'flouring.' The patio process made a heavy draft on the quicksilver resources of the world. From 1875 to 1883, when silver mining was at its height, the output of quicksilver in California was 50,000 flasks per year; now it has fallen to less than 16,000. Formerly it was sent in car-loads to Montana and Mexico; smelting and cyaniding have now displaced amalgamation. An interesting move in connection with quicksilver is the decision of the Du Pont de Nemours Powder Co., of Wilmington, Delaware, to acquire mines so as to be independent of the market and to manufacture fulminate. At the present time most of the fulminate used in the United States is imported from Canada where it is made from mercury bought in England. If the powder companies generally adopt this new policy, the demand for quicksilver in the United States will revive.

Arsenic at Midvale.—Leroy A. Palmer describes in *Mines and Minerals* for June the plant erected at the Midvale lead smelter belonging to the United States Smelting Co., near Salt Lake City, Utah. This article is supplementary to the one abstracted in our April issue describing the methods adopted at this smelter for preventing lead and arsenic fume from escaping into the atmosphere. The arsenical fume caught in the bag-house contains an average of 44% lead and 21% As_2O_3. It is obvious that a complete expulsion of the arsenic cannot be attempted, as too high a heat will either soften or volatilize the lead content. In practice an extraction of from 50 to 60% is effected. The roasting-plant consists of two Brunton furnaces, each with a capacity of 16½ tons per day. This type of furnace is well known, being in use at Anaconda and elsewhere, but as the drawings and the details of construction given by Mr. Palmer are unusually detailed we reproduce them here. The material to be treated is dumped from cars on the 18 in. track (*b*) into the hopper (*a*). The hopper measures 3½ by 4 ft. at the top, and is 5 ft. deep; it is kept full so as to prevent air entering the furnace. The revolving hearth (*e*) is carried on the spindle (*c*), the upper part of which projects into the hopper, where blades attached to it serve to prevent packing of the charge and so to assure a regular feed. The rate of feed can be regulated by raising or lowering the sleeve (*d*), which is a prolongation of the cylindrical portion of the hopper; by this means the distance between the bottom of the hopper and the hearth can be varied from 3 to 17 in. The sleeve is 11¾ in. diameter and 16 in. high. The rabbles (*f*) are arranged in three sets of eleven set at 120° apart. The rabbles are pieces of ¾ in. iron set at an angle of 30° to the tangent of their circular path. They project upward through the roof of the furnace and their height above the hearth (*e*) can thus be adjusted; usually this distance is 3 in. The walls of the furnace are made of firebrick 8 in. thick, bound with a sheet of $\frac{3}{16}$ in. steel. The inside height of the furnace is 3 ft. 4 in., and the arched roof is 9 in. higher at the centre. The inside diameter is 14 ft. 6 in. and the hearth comes to within 4 in. of the sides. The hearth is built up of twelve radial steel arms (*h*) which support eight circular angle-irons (*g*). A course of firebrick 2 in. thick is laid on these irons and then covered with a layer of cement 1 in. thick. The slope of the hearth is 1 in 10. The central supporting spindle (*c*), which is 5 in. diam., passes through the bottom of the furnace and is supported by a bearing resting on a concrete block. A driving wheel (*i*), 55 in. diam., is keyed to it, and motion is given by the worm gear (*j*). The rate of revolution is once in 5 minutes, at which rate it takes 10 to 12 hours for the charge to travel from

the centre to the outer edge. A 5 h-p. motor drives the two furnaces. Each furnace has two brick fireplaces (*k*) set 60° apart; their fire-doors are at the ends and in such a position that they can be stoked from one central point. The fire-boxes measure 20 by 44 in. and the exits for gases measure 13 by 44 in. Four doors (*l*), measuring 10 by 18 in., two above and two below the hearth, allow access to the interior. The gases and volatilized arsenic pass out through a 24 in. iron pipe (*m*) into the flues and settling-chambers. The coarser arsenious acid settles here and the finer fume is caught in woollen bags. Coke is burned on the fire-grates. The temperature on the hearth is about 900° F.



THE BRUNTON FURNACE FOR TREATING ARSENICAL FUME.

and in the first chamber of the settling-flue 600° F. The leady residue left after roasting is discharged through the opening (*n*) at the back of the furnace. The arsenious acid produced averages 96 to 98% fine. The cost of treatment is $5 per ton of fume, or, taking a production of 55% of the arsenic content, which averages 21% of the fume, 2½c. per pound of arsenious acid produced. The arsenic is subsequently refined in a reverberatory, which has a hearth measuring 20 by 10 ft., and a final product 99·8% fine is eventually obtained. The impurities of the refined and unrefined material are chiefly antimony and lead arsenate. The refined arsenic is subsequently ground to powder in a 3 ft. buhr mill. The cost of powdered refined white arsenic is 2¾c. per pound and the cost of transport to New York is ⅝c. per lb., so that the cost at the market is 2¾c. Seeing that the present selling price is 4½c. per lb. it is clear that the new plant does not yet make a profit. It is shown however that much cost of labour could be avoided by providing automatic methods of bringing the fume from the lead-smelter bag-house to the Brunton furnace. The cost of treatment in the furnace is also a question to be considered. Probably some more modern furnace would give better results.

Distribution of Manganese Ores.—*Revue de Metallurgie* publishes an article by A. Haenig on the production and distribution of manganese ores in various parts of the world. The late political troubles in Russia caused the prices of Caucasian ores to rise, and the continental buyers therefore had to study other sources of supply, especially those of India and Brazil. The author points out that there are two classes of industrial manganese ores, one class being suitable for the production of spiegeleisen and ferro-manganese, and the other applicable in chemical processes for oxidizing purposes, the manufacture of chlorine, glass, etc. Poorer quantities are suitable for the former purpose, but only the rich for the latter. The author then proceeds to classify the deposits and to describe the theories of their formation. He points out that all the ores contain admixtures of many other metals, and instances

the rich pyrolusite from the Caucasus which contains on an average 85% MnO_2 and small amounts of iron, lead, copper, magnesium, cobalt, nickel, zinc, arsenic, besides earthy matters, lime, barite, silicates, etc. The author gives an exhaustive table of analysis of ores from all parts of the world.

In Europe manganese ores are mined commercially in Russia, Germany, France, Greece, Italy, Austria-Hungary, Spain, Turkey, and Great Britain. The most important deposit in Russia is in the Caucasus, where, in the valley of Tschiatura, 120 square kilometres of country is estimated to contain 90 million tons of high-grade pyrolusite. (See *Mining Magazine* for June.) The next district of importance is in Ekaterinoslav, where 33 million tons of ore is estimated to be suitable for mining. The pyrolusite here occurs in nodules and the average *Mn* content is not over 45%. There are also deposits in the Ural and near Tiflis, both of less importance. The German production comes chiefly from the Coblenz mining district; the *Mn* content is usually low compared with that of imported ore. France has mines in the south, but imports most of the ore used. The Greek deposits are in some of the islands and are not worked at present as they are of too low a grade. Ores are found in four districts in Italy but are of little value. Austria-Hungary contains deposits in various districts, but that at Bukovine is the only one of importance. The output in this district is large, equalling that of the Caucasus. The ore consists of a mixture of pyrolusite and rhodonite and by dressing two products are obtained one containing 70% MnO_2 and the other 35%. The deposits are reported to contain large reserves. The British production comes from Wales, but is small. The Spanish production comes from the provinces of Asturias and Huelva. The deposits have yielded much ore though the output is irregular. The content decreases with depth, and the ores cannot compete with those from Russia and other exporting countries. The Turkish deposits are numerous but little known as yet. They are mostly in Asia Minor on the shores of Marmora sea and in Smyrna district. The output of the Kassandra mine is large. The future of Turkey as a producer seems promising. In Africa work on a manganese deposit in Paarl district, Cape Colony, started in 1905. The only producer in Australia is at Mount Miller, Queensland, where a high-grade ore is mined.

In the United States manganese ores are produced in California, Georgia, Tennessee, Virginia, Arkansas, and Texas. Some of the Lake Superior iron ores contain 4% *Mn*, and manganese is also obtained as a residual product of the New Jersey zinc ores. The production is small compared with the imports from Brazil, India, and Russia. Cuba is a producer, having mines in the district of Santiago yielding rich ores and large quantities of low grade ores that require dressing.

As regards South America, the Brazilian production has recently revived with the introduction of railways. Companies of all nationalities are conducting operations, six having important concessions in the province of Minas Geraes. The states of Bahia and Matto Grosso are coming forward as producers and the ore exported from the latter will soon approach an important figure. Chile has deposits in the provinces of Atacama and Santiago. In Asia the most important deposits are in India where English capital has founded a great industry. The ores are psilomelane and pyrolusite and the content is high. In the State of Mysore six concessions contain 30 workings and the average content is 65 to 70%. There are 17 properties developed in Nagpur, 14 in Bhandara, 10 in Balaghat.

Studies in Concentration. — In the *Engineering and Mining Journal* for June 11, Theodore J. Hoover presents a discussion of various points in connection with the calculation of the proportion of recovery in concentration. He commences with a demonstration of his method of calculating the percentage of recovery and ratio of concentration when only the percentage assay-values of the ore, concentrate, and tailing are known, and not the relative tonnages. This is quite a simple mathematical problem. If we take x, y, and z, as the undetermined weights of the ore, concentrate, and tailing, and a, b, and c as the percentage of metal contained in each as ascertained by the assay of a sample, then the constitution of the ore, concentrate, and tailing, and the amount of metal contained in the three, are expressed by the two formulæ:

$$(1) \quad x = y + z$$
$$(2) \quad ax = by + cz$$

The ratio of concentration is expressed by the fraction $\frac{x}{y}$, and the percentage of recovery by $\frac{100\,by}{ax}$. Eliminating z from the two equations, by multiplying (1) by c, and subtracting, we get $(a-c)\,x = (b-c)\,y$. Thus $\frac{x}{y}$, the ratio of concentration, is represented by $\frac{b-c}{a-c}$. Substituting this ratio in the formula for the percentage of recovery we get the percentage expressed thus: $\frac{100\,b\,(a-c)}{a(b-c)}$. These two formulæ are independent of the value of x, y, and z. It will be seen also that if we have the percentage assay-values of the ore, concentrate, and tailing, we can deduce the relative amounts of concentrate and tailing for, say 100 parts of ore. This is done by substituting 100 for x and $100-y$ for z in equation (2) and solving for y.

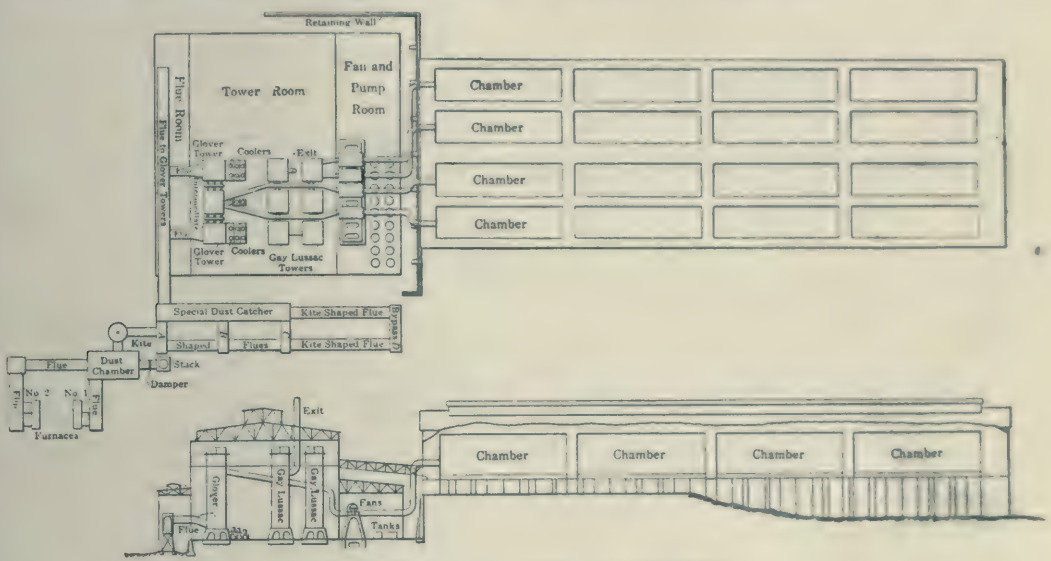
As a rule the percentage of recovery and the ratio of concentration are ascertained by measuring z, y, a, and b. There are many occasions when this cannot be so conveniently and easily done as by this method based on sampling. Mr. Hoover points out that his method depends for its success on the degree of accuracy of the sampling and of the assay; we do not suppose that the possibility of error need be greater than when the ore and concentrate are weighed daily and their contents sampled. The two methods might with advantage be used as a check one on the other. Mr. Hoover proceeds to show how his method can be employed for studying the accuracy of analyses, and how errors are introduced into the figures for extraction by inaccurate samplers and chemists.

Sulphuric Acid at Ducktown — As is generally known, the smelters in America have recently had to adopt means of preventing the escape of acid and other deleterious products into the atmosphere. The Ducktown Sulphur Copper and Iron Co., an old-established English company, received notice from the Georgia State authorities that the acid nuisance must be suppressed, and accordingly in June 1908, N. L. Heinz was commissioned to erect a chamber plant. This started work within a year, namely in June 1909, and has given great satisfaction. W. H. Freeland and C. W. Renwick describe the plant in the issue of the *Engineering and Mining Journal* for May 28. The Ducktown company has not been a willing offender, for many attempts have been made previously to utilize the sulphur content of the ore. Heap-roasting was abandoned early in favour of pyrite smelting, and the experience gained has formed the subject of discussion among metallurgists. Much money was also spent in experimental trials of the ferric oxide contact

process for converting the sulphurous into sulphuric acid, but without any success. It was supposed that the gases from a semi-pyritic blast-furnace would not be amenable to the chamber process for the reason that much dust and carbonic acid are present. The dust contains zinc compounds which are worth recovering. The carbonic acid comes not only from the coke but from the carbonate of lime in the ore. Another trouble is the irregularity of the temperature of the gases from the furnace.

The plant was designed for a capacity of 160 tons of chamber acid per day averaging 60° Beaumé, and in practice it has been found possible to produce 200 tons per day. The smelter consists of two blast-furnaces, but only one is in use at present as the acid-plant is not large enough to treat the gases from both. The gases on an average contain 3½% each of SO_2 and CO_2 and traces of SO_3, but the composition varies greatly. For six days of the week the furnace smelts pyrrhotitic ore containing from 14 to 19% sulphur, and the seventh is devoted to the concentration of the low-grade matte, which contains about 25% sulphur. The production of acid from the matte is an easier process than from the ore.

Referring to the illustration it will be seen that the smelter gases go through the old dust-chamber. The old chimney-stack is not now used. From the dust-chamber the gases pass up a cylindrical tower, then through a series of kite-shaped flues, and afterward through a dust-catcher of special design. The series of flues are provided with dampers so that some of them may be cut out; in this way the length of travel of the gases may be regulated according to their initial temperature. The dust-catcher is intended for the recovery of the zinc and other impalpable dust. It is a rectangular brick chamber filled with horizontal channel-irons, which present a great surface for settlement. These are fixed in bearings in each wall and the trunnions at one side pass through the wall. They can therefore be periodically turned over so as to discharge the dust collected in the channels. From the dust-catcher a brick flue takes the gases to the acid-plant. The gases pass up two Glover towers, which measure 12 ft. square and 45 ft. high, where they mix with nitrous fumes from the nitre burner. The mixed gases subsequently pass up another tower between the other two, and then along two lead flues 42 in. diam. to the chambers. The circulation of the gases is effected by means of four fans made of antimonial lead arranged between the tower room and the chambers. There are 16 chambers each measuring 96 ft. long, 22 ft. 8 in. wide, and 30 ft. high, and their total volume is 1,050,000 cu. ft. After the oxidation of the SO_2 in the Glover towers and chambers and the condensation of the H_2SO_4 in the latter, the gases go to Gay-Lussac towers where the nitrous gases are absorbed by strong sulphuric acid, and returned to the Glover towers. The method devised for overcoming the disadvantages due to the presence of carbonic acid is not described in the article. The quality of the acid produced is of a much higher grade than was originally expected. The engineers had contemplated obtaining only a 'sludge' acid, and they are therefore pleasantly surprised to find that the acid produced is practically pure.



SULPHURIC ACID PLANT AT DUCKTOWN.

Porcupine Ore.—The *Canadian Mining Journal* for June 15 contains a large amount of information about the newly discovered Porcupine gold-mining district. One article is by W. E. H. Carter, who was formerly Inspector of Mines for Ontario, and gives his impressions of the present developments and future prospects. The others are by H. E. T. Haultain, Professor of Mining in the University of Toronto, who discusses the methods required for sampling Porcupine ore. His description of the ore is interesting. The gold occurs so irregularly that sampling will be exceedingly difficult and he is of opinion that frequent and large samples will be necessary. The gold varies from fine flour to very coarse, without ever being in such large pieces as to form nuggets. It occurs free and is also associated with pyrite, galena, and blende. The content varies inch by inch across and along the veins, and there are many places where the vein-matter, white quartz or schist, is quite barren. Mr. Haultain writes at length on the subject of sampling, and makes suggestions for field methods of quartering applicable to the sampling of large quantities of ore with irregular content.

CURRENT LITERATURE

Chlorination.—In the *Mining World* (Chicago) for May 7, W. H. Storms describes the method of chlorinating concentrate at the Kennedy mine, California. This process has been in use for many years and the plant at the Kennedy mine is the last left of many that used to treat concentrate locally.

Dredging in Siberia.—In the *Mining and Scientific Press* for May 7, W. H. Shockley quotes at length a report by a Russian government commission on the cost of gold-dredging in Siberia.

Nickel-Copper Industry of Ontario.—In the *Mining World* (Chicago) for May 14 and 28, Alexander Gray gives a historical account of this industry and of the present condition of the various mines.

Impounding Tailing.—In *Mines and Minerals* for May, R. L. Herrick describes the methods adopted by the three chief milling plants in Colorado City, where Cripple Creek ores are treated. The tailing contains much fine clay which was carried down the streams without settlement. As the water of these streams was required for irrigation purposes, means had to be provided for settling the solid content.

Amalgamating in Tube-Mills.—In the *Mining and Scientific Press* for April 30, H. W. Hardinge gives the results of trials by J. M. Elmer, in California, with quicksilver in conical pebble-mills.

Secondary Enrichment.—A paper was read by F. L. Ransome at the April meeting of the Canadian Mining Institute entitled 'Criteria of Downward Sulphide Enrichment.' The paper gives a general summary of the various lines of evidence indicating whether or not the process had been operative in any given case.

Costs of Mining and Treatment.—In the *Mining and Scientific Press* for April 30, A. E. Drucker gives an account of the costs at the mine of the Oriental Consolidated in Korea, where gold ore containing as little as $2·75 per ton can be treated at a profit.

Jarbridge.—In the *Mining and Scientific Press* for April 30, W. A. Scott gives an account of the new mining district of Jarbridge, Nevada.

Reverberatory Practice.—In the *Mining and Scientific Press* for April 23, E. M. Clark describes a small reverberatory erected by him in Sonora, Mexico, for treating copper ores, and gives an account of his results.

Loss of Copper in Slag.—In the *Engineering and Mining Journal* for April 9, C. A. Grabill contributes to the discussion started some months ago by Lewis T. Wright on loss of copper in slag.

Smelter Fume.—In the *Mining and Scientific Press* for March 12 there is an article describing the terms of settlement of the dispute between the farmers in Shasta county, California, and the Mammoth Copper Co. The smelter is to catch its sulphuric acid and metallic fume by the Sprague method described in our December issue.

Copper Determination.—In the *Engineering and Mining Journal* for May 7, T. W. Cavers and J. P. Chadwick describe the methods of electrolytic determination of copper used by the Tennessee Copper Co.

Converters.—In the *Engineering and Mining Journal* for May 7, Herbert Haas describes the operation of the 'vortex' converter in which the tuyeres are arranged in the bottom of the converter in such a manner as to give a whirling motion to the charge.

Lead and Zinc Smelting in Upper Silesia.—In the *Engineering and Mining Journal* for May 21, Otto H. Hahn reviews recent progress in the metallurgical treatment of lead and zinc ores in Upper Silesia.

Analysis of Cyanide.—In the *Engineering and Mining Journal* for May 28, Ralston Bell describes a rapid method for the analysis of commercial cyanide.

Sulphuric Acid at Ducktown.—In the *Engineering and Mining Journal* for May 28, W. H. Freeland and C. W. Renwick describe the new plant at the Ducktown smelter, Tennessee. Pyrite smelting is used and the gases from the blast-furnaces are treated by the chamber process. The production of acid is 160 tons daily.

Assay of Tin Ores.—In the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for March, James Gray presents a paper on the assay of tin ores. This paper gives a review of current practice and is intended to form a basis of discussion, so that a standard system may be evolved for the assay of tin ores from South African mines.

Oilfields in New Zealand.—The *Mining Journal* for June 11 contains the first part of an article on the oilfields of New Zealand.

Flocculation.—In the *Journal* of the Franklin Institute for June, E. E. Free contributes a paper on flocculation. The author discusses the behaviour of fine particles suspended in water and their tendency to agglomerate. The paper will be useful as a side-light on the unexplained phenomena of concentration by flotation.

Evolution of Mine Haulage.—In the June issue of *Mines and Minerals*, E. B. W. (Eugene B. Wilson, the able editor) contributes an interesting article on the evolution of mine haulage. He describes the methods adopted in various countries for utilizing human labour and the different ways of hauling and carrying; he also discusses the services of mules, dogs, and oxen. The accompanying illustrations are most informing.

The 'Parral' Vat.—In the *Mining and Scientific Press* for May 28, Bernard MacDonald describes his vertical vat for treating gold and silver by cyanide. The bottom is divided into V-shaped pockets, and the compressed air for agitation comes through inclined pipes, thus causing a whirling motion. The charge is delivered through pipes which deliver it under a hydrostatic head at the bottom of the pockets. Vats of this type are being erected at Veta Colorado mine, Parral.

Terry Core-Drill.—In the *Engineering and Mining Journal* for June 7, the Terry core-drill is described. This drill is a variation of the shot type, and is capable of cutting holes up to 30 in. diam. It is proposed to use the drill for making ventilating shafts and emergency exits.

Electrolytic Determination of Copper.—In the *Western Chemist and Metallurgist* for May, F. W. Traphagen describes the methods of electrolytic determination of copper used at Anaconda.

Assaying Sulphides for Gold.—In the *Engineering and Mining Journal* for June 11, F. G. Hawley describes the method used at Cananea for assaying sulphide ores for gold. The method consists of a rough estimation of the amount of sulphides in the ore and calculating the requisite amount of nitre.

Balaklala Copper.—In the *Mining World* (Chicago) for June 11, A. H. Martin describes the Balaklala copper mine and smelter in California.

Silver Ore.—In the *Engineering and Mining Journal* for June 18, Josiah Bond describes a new occurrence of silver, found in the Santa Rita mountains, Arizona. The silver is found in diorite, enclosed in secondary magnetite, and the author considers it to be an original constituent of the rock. He refers also to the case of copper being present as a primary mineral in the First Mountain trap in New Jersey.

Geology of Petroleum.—In the June issue of the *Bulletin* of the American Institute of Mining Engineers, David T. Day continues a subject on which he wrote in 1897 and subsequently at the Petroleum Congress held at Paris in 1900, namely, the variations in the colour, chemical composition, and specific gravity of petroleum in various parts of the world and sometimes in different parts of the same oilfield. The basis of Mr. Day's paper is that variations are due to fractionation by diffusion through porous strata.

Blast-Roasting.—In the June issue of the *Bulletin* of the American Institute of American Engineers, H. O. Hofman reviews at length the recent progress in blast-roasting, otherwise pot-roasting or lime-roasting.

Stope-Drill Competition.—The *South African Mining Journal* for June 4, gives the text of the preliminary report of Stope-Drill Committee and describes with illustrations the mechanism of the three winning machines, the Holman 2½ in., the Siskol, and the Chersen.

Cyanide Practice at Esperanza. — In the April *Memoirs* of the Mexican Mining and Metallurgical Institute, M. H. Kuryla describes the new cyanide plant at the Esperanza mine, El Oro, Mexico, dealing particularly with the agitation in the Pachuca vats on the continuous system.

BOOKS REVIEWED

GEOLOGY: SHORTER COURSE. — By Thomas C. Chamberlin and Rollin D. Salisbury. Cloth, 8vo. 978 pages. Beautifully illustrated. London: John Murray. Price 21s. For sale by *The Mining Magazine*.

This is a convenient condensation of the three volumes on geology previously published by the chiefs of the departments of geology and geography in the University of Chicago. Like the earlier treatise for advanced students this book is beautifully printed and illustrated. We know of no publication on the subject in which the maps, drawings, and photographs have been so well reproduced. How it would have delighted the fathers of modern geology, such as Lyell and Murchison! For while the artistic feature is not negligible, it is obvious that the illustrations must stimulate interest in the descriptions, as well as facilitate the appeal to the constructive imagination of the young geologist. We are glad that the student can now possess in one book what was previously distributed over three expensive volumes, for this is a publication well worthy of general use. The authors rank among the leaders of scientific thought in America and possess ample experience in teaching; therefore the treatment of the subject is well adapted to real scientific instruction. They view geology as the life history of the earth and avoid unnecessary diversions into controversial matters, endeavouring rather to lay stress on the work of rivers, the agency of snow and ice, and the origin of rocks, together with the kindred elementary, but fundamental, operations contributory to the shaping of the earth's exterior. Frankness of statement and express acknowledgment of the limitations of knowledge are admirable features of the book. So also is the effort to keep hypothetical conclusions separate from established doctrines. But the authors have not hesitated to introduce new conceptions and to break fresh ground. Therefore the book departs occasionally from beaten paths and includes ideas current in the geological discussion of the present day. It is an admirable piece of work and does credit alike to authors and publisher.

T.A.R.

OILFIELDS OF THE EMPIRE.—By J. D. Henry. Cloth, quarto. 280 pages. Ill. London: *The Petroleum World*. Price 18s. For sale by *The Mining Magazine*.

The author of this handsome book is the editor of *The Petroleum World*, and is the author of books on Baku, oil-transport, tank-steamers, etc. The main object of the book is to aid the development of oil deposits within the British Empire. The author is convinced that oil will eventually become the motive power of steamers and battleships, and taking this view he sees the necessity of having sources of supply within the Empire. Half of the book describes Trinidad and the other half Newfoundland. The author apologizes for the fact that his book is incomplete. He has much information relating to Barbados and New Zealand ready for publication, but the pressure of other business makes it impossible for him to publish it at the present time. Mr. Henry is to be commended for not delaying until he can say the last word. The book describes the deposits of Trinidad and Newfoundland, historically and geologically, in great detail, and the author brightens his pages with personal touches.

ELEMENTS OF MINING AND QUARRYING.—By Sir C. Le Neve Foster; Second Edition, revised by S. Herbert Cox. Cloth, 8vo. 340 pages. Ill. London: Charles Griffin & Co. Price 7s. 6d. For sale by *The Mining Magazine*.

This was the last book written by Sir Clement Le Neve Foster and was published at the beginning of 1904. Many books with the word 'Elements' in their title, being written by young lecturers for young students, are unsatisfying though good enough for their purpose. Le Neve Foster's is a different book. It is the condensed experience of a master mind, gained during an active and varied life. It serves as a guide to others than the young student; to the engineer who wishes to refresh his memory or to ascertain the author's views, to the director, financier, and shareholder who desires to acquire an intelligent insight into the principles of mining.

The first chapter describes ore deposits and veins, and shows generally how the various metals and minerals occur. Chapter II. describes the conditions favouring the discovery of deposits and the methods of searching for them. Then follow chapters on testing ground by boring and drilling, on rock excavation, timbering, methods of developing, haulage, hoisting, drainage, ventilation, and lighting. The subject of dressing and concentration then receives attention, and the remaining chapters deal with legislation, condition of the workmen, and accidents. The illustrations are good, and the photographs add to the general interest.

The book was so thoroughly up-to-date when published that Mr. Cox's labours in revision and addition have been comparatively light. It is always a difficult matter to continue the work of another author especially when that author was a 'personality.' Therefore this book will always be identified with Le Neve Foster and the doubt may be expressed whether the bracketing of his name with that of the Professor who is his worthy successor at South Kensington is altogether desirable. Some years ago John Murray, publisher of Percy's 'Metallurgy,' commissioned the late Hilary Bauerman to complete and revise the series, but Mr. Bauerman soon abandoned the idea. As well ask Sir Edward Elgar to complete Beethoven's unfinished symphony.

WHO'S WHO IN MINING AND METALLURGY, 1910.—Founded by George Safford. Price 15s. London: *The Mining Journal*. For sale by *The Mining Magazine*.

This is a new edition of a useful and handsome book of reference. Of the 272 pages, 147 are devoted to biographic paragraphs and 125 to the personnel of the various technical and professional societies. The length of the 'records' is not proportioned to the achievements of those chronicled, for the editor has allowed each man the fullest latitude. This gives added interest to the biographic details, and explains some of the errors. For instance, in the account of H. F. Marriott we read that he was "Asst. to Mr. Hennen Jennings, Past-Pres. I.M.M., etc.," from which one might infer that Marriott, not Jennings, was an ex-President of the Institution. In one case the note regarding a fledgling is as long as that devoted to an old bird, his father. Not many men state the year of their birth, thus omitting an essential fact. The names of firms are included, although these have a biographic interest that is apt to be ephemeral. The book is, however, a useful volume and we are glad to see a second edition, but we do venture to suggest that the editor should accept a larger share of responsibility, introducing greater uniformity and increased authoritativeness. The editor labours under the disadvantage of not having received the support of many engineers, who either look slightingly at the book, consider themselves superior persons, object to professional advertising, or are too lazy and indifferent to take the trouble to answer the editor's polite request for details. We would urge all such defaulters to render service by collaborating in such a way as to make the book thoroughly representative. The value of such a publication depends on its completeness.

NEW PUBLICATIONS

AMERICAN PRODUCER-GAS PRACTICE AND INDUSTRIAL GAS ENGINEERING. — By Nisbet Latta. Cloth, large octavo. 560 pages. Ill. New York: D. Van Nostrand Co.; London: Crosby Lockwood & Son. Price 25s. For sale by *The Mining Magazine*.

This is an elaborate book on American practice in the manufacture of producer gas. It contains chapters on the manufacture of producer gas from crude oil, powdered coal, and wood.

ORE MINING METHODS. — By Walter R. Crane. Cloth, octavo. 225 pages. Ill. New York: John Wiley & Sons; London: Chapman & Hall. Price 12s. 6d. For sale by *The Mining Magazine*.

This book contains descriptions of methods of timbering and supporting rock in place, methods of stoping and mining in narrow and wide veins and bedded and massive deposits, including stull and square-set mining, filling and caving, open-cut work, and a discussion of costs.

THE CYANIDE HANDBOOK.—By J.E.Clennell. Cloth, octavo. 520 pages. Ill. New York: The Magraw-Hill Book Co.; London: Hill Publishing Co. Price 21s. For sale by *The Mining Magazine*.

This book collects and discusses the scattered literature on the chemistry of the cyanide process.

MINING LAW OF MEXICO.—By R. J. Kerr. Cloth, 69 pages. Chicago: Pan-American Law Book Co. Price 6s. 6d.

This book gives a translation of the new mining code adopted by Mexico at the beginning of the present year.

THE OIL-FIELDS OF TRINIDAD. — By A. Beeby Thompson. Pamphlet, 40 pages. Ill. London: The West India Committee. Price 6d. For sale by *The Mining Magazine*.

This pamphlet contains an amplification of a lecture delivered in April by Mr. Beeby Thompson under the auspices of the West India Committee. It is a useful guide to the industry and, coming from an author so well versed in oil deposits and so intimately acquainted with the island, it will serve an excellent purpose.

BETWEEN LAKE NIPIGON AND CLAY LAKE.—By W. H. Collins. 70 pages with diagrams, illustrations, and maps. Ottawa: The Government Printing Bureau.

This volume is published by the Geological Survey of Canada, and gives a geological reconnaissance of the region traversed by the National Continental Railway between Lake Nipigon and Clay Lake, Ontario. Gold is found in the granite and schist in this region, but usually in too small amounts to be profitable. The only active work is in the Sturgeon Lake district.

MEASUREMENT OF PULP AND TAILING.—By W. J. Sharwood. Pamphlet, 24 pages. Ill. London: *The Mining Magazine*. Price 2s.

This is a reprint of Mr. Sharwood's articles that appeared in *The Mining Magazine* for November, December, and January. The information contained in the articles has proved to be of great value to metallurgists and this issue in separate form has been made to supply a demand.

MINING LAW OF THE REPUBLIC OF MEXICO. — Translated by Courtenay de Kalb. Pamphlet, 24 pages. San Francisco: *Mining and Scientific Press*; London: *The Mining Magazine*. Price 2s.

This pamphlet gives an accurate translation of the new mining law of Mexico, that came into force on January 1. It has had the benefit of critical revision by Judge Lindley, the leading authority on American mining law, and by O. Molina, Secretary of Fomento in Mexico. The translation may therefore be taken to be authoritative and reliable.

OIL HANDBOOK. — Paper covers. 120 pages, with maps. London: *The Financial Times*. Price 1s. For sale by *The Mining Magazine*.

This pocket-book gives information about all the companies on the London market formed for the purpose of producing oil.

ROUND RHODESIA.—By J. W. Broomhead. Pocket size. 190 pages, with maps. London: *The Financial Times*. Price 2s. 6d. For sale by *The Mining Magazine*.

This convenient handbook gives particulars of all the finance and mining companies working in Rhodesia and of the individual mines and properties. It is compiled on a similar plan to that of 'Round the Rand,' which the author produced a year or more ago.

THE JOURNAL OF THE INSTITUTE OF METALS.—Vol. III., part 1. Cloth, 8vo. 370 pages. Ill. Published by the Institute. Price 21s. For sale by *The Mining Magazine*.

This remarkably successful society now publishes two volumes of transactions yearly, covering the proceedings at the winter and autumn meetings respectively. The volume before us contains the papers, and the discussions on them, presented at the meeting held in London in January last.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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REVIEW OF MINING

INTRODUCTORY.—During most of July the wretchedness of the weather was enough to extinguish the buoyant spirit of speculation; indeed, a clergyman wrote to a daily paper imputing the perpetration of a series of murders to the depressing effects of rain and wind, but if the weather sufficed to induce such deeds of crime, the British people would never have won a reputation as a law-abiding community. No; the gloomy weather is with us most of the time, and we can be cheerful despite it. More probably a large failure at Paris, followed by another at Vienna, with enforced liquidation in the London market, was a more potent influence, and on the top of that came a number of fiascos or checks quite enough to dampen enthusiasm. The Golden Horse-shoe, Associated, and Great Fitzroy episodes were all of a character prejudicial to cheerfulness. We refer to the subject elsewhere.

Even favourable monetary conditions, as indicated by the low Bank rate, have failed to create a demand for the better kind of investment stocks. This is not surprising, having regard to the large amount of securities yet to be digested. The market resembles a boa constrictor that has swallowed a whole pig. Lassitude must ensue until assimilation is completed. During the first half of the current year £188,000,000 of capital was subscribed in London, as compared to £182,000,000 during the whole of 1909. Even these figures do not include the shares taken by vendors, but merely those absorbed by the public. Only £2,815,000 went for British railways, the bulk of the subscriptions being used to finance enterprises abroad. Since January 208 rubber companies have been formed, taking £25,000,000, of which, in six months, the public contributed fully £17,000,000, but this does not include premiums, which would bring the public contribution to more than £20,000,000. Oil companies have required £9,000,000, and are likely to make further demands. In the main it is the small capitalist that has contributed all this money. Another interesting feature is the heavy taxation of incomes, inducing a neglect of Consols and other gilt-edged investments of small earning power, and prompting people to take larger risks in the hope of bigger gain. This undoubtedly helps to stimulate the gambling in new issues promising fat dividends, and it will continue to prompt the diversion of money into mining shares and other securities offering "a good run for the money." If the speculator will recognize his risk and be careful not to 'over-extend' himself, he may do well. The danger lies in confusing gambling with investment.

TRANSVAAL. — An analysis of the results obtained by the leading mines of the Witwatersrand during the first half of 1910 is not cheerful. Evidently all that we have said from time to time concerning the scarcity and inefficiency of labour, and the combined effect on the cost of operations, is confirmed. Although the yield of gold per ton compares well with that recorded in the corresponding half of 1909, the increase of expenditure has compelled most of the companies to acknowledge a diminution of profit. In some cases this is due to exceptional causes, such as a disabled shaft at the Ferreira Deep and the Robinson Central Deep, and a faulted lode at the Luipaard's Vlei, but in many instances it is confessed that the disappointing results are due to the labour difficulty. Thus the Crown Mines consolidation exhibits a rise of 2s. 8d. in expense per ton, causing the profit to drop from 17s. 8d. to 14s. 9d., although the ore yielded 32s. 4d. as against 32s. 7d. last year.

This is due to a reduction in the tonnage treated from 828,373 to 767,000. At the Durban Roodepoort Deep the profit has been cut in two, from 8s. 7d. to 4s. 2d. per ton. For a similar reason—inadequate labour supply—the Witwatersrand Deep, Jupiter, Simmer Deep, Village Deep, Nourse Mines and other companies report smaller profits on a decreased tonnage. Almost the only notable expansion is at the Modderfontein, which crushed 94,000 tons more and won a profit £50,000 greater than last year. Increased yield per ton is exhibited by the Geldenhuis Deep, Village Main Reef, City & Suburban, Main Reef West, and Ferriera Deep. On the other hand a lower yield with a larger tonnage has enabled the Knight Central and Jumpers to earn increased profits. During the latter half of the current year the effect of the 'square fathom' policy, with an improvement in grade at the expense of tonnage, will become apparent in a few mines, and concurrently the seasonal migration of Kaffirs will tend to cripple production at others.

While it has been surmised that the Main Reef series extends into the Orange River Colony, hitherto no work has been done to test a fascinating geological theory. But now the Free State Banket Development Co. with a capital of £150,000 is prospecting the country near Parys, 13 miles southeast of the Vaal river. This exploratory work is being done under the advice of Mr. Corstorphine. Actual boring will follow surface trenching, and, of course, the discovery of profitable ore in this locality would lead to important developments. On another page we publish a map exhibiting the relative position of the various outcrops of the Witwatersrand series.

The annual meeting of the Central Mining and Investment Corporation is usually signalized by some thoughtful remarks from Sir Julius Wernher. He referred to the gold-mining industry of South Africa as being so "established" as to be "somewhat less interesting from a Stock Exchange point of view." This induces greater stability in quotations. The policy of the managers is to obtain the highest profits, and this is not always coincident with the lowest costs. Sir Julius mentioned the names of two mine managers (H. M. Thomas and W. T. Anderson) who have been conspicuously efficient. He assured his audience that there was no intention to withhold information but only to provide a better check on the operations. He spoke optimistically on the labour supply and referred to the cheerful increase of white labour, which is 13½% greater than a year ago. He concluded by saying that "the outlook is distinctly favourable."

RHODESIA.—An official circular has been issued by the Globe & Phœnix company, giving a summary of the ore in reserve on June 30, from which it is seen that 174,788 tons averaging 32·259 dwt. and containing gold to the value of £1,184,097 is available, as against 163,931 tons of 31½ dwt. stuff, and £1,097,000 in value, on March 30 of this year. This is the best showing hitherto made by this mine. On the 16th level rich ore has been followed in the drift for 440 ft., but the 17th level has not yet reached the main orebody, although the winzes from the 16th are in good ore. Owing to repairs in the shaft this development work cannot be resumed until September.

The Rhodesian Broken Hill is to be developed further, it being stated that the question of ore treatment has been solved by experiments, warranting the erection of a new plant. This is an important deposit of lead and zinc ore.

Early in August a favourable turn was given to the Rhodesian market by the announcement that the Chartered company is working in unison with the other Rhodesian houses in the remodelling of the Native Labour Bureau. This institution when reorganised will have a working capital of £100,000, of which one-half will be subscribed by the Chartered company.

WEST AFRICA.—News from the mines is generally favourable. The Broomassie reports 6 ft. of 2 oz. ore on the 770 ft. level, and 1½ oz. for a width of 2 ft. at 990 ft. The Prestea Block A is opening up well in the Appantoo section. The deal between the Wallis Company and the Consolidated Mines Selection has been consummated. The capital of the Wallis Co. was increased to £250,000 during July by the creation of 100,000 new shares, of which 50,000 are to be offered at £2 to the shareholders with an option of buying 25,000 more within two years at £2. 10s. The issue of 50,000 has been guaranteed by the Consolidated Mines Selection, and the latter company acquires the right to nominate two directors. Another company issuing new capital is the Prestea Mines. Here a new main shaft is to be sunk, at a cost of £30,000, and to provide this amount and to supply working funds, the remaining unissued shares (119,060) are to be offered for subscription at 7s. 6d. The property of this company is under option to Prestea Block A, and the prospects are good enough to warrant a supposition that the option will be exercised.

AUSTRALIA.—The discovery of pay-ore at the lowest point in the Great Fingall mine is encouraging. In a winze below the seventeenth level (2200 ft. vertical) a lode 10 to 12 ft. wide, averaging 4½ dwt. per ton, is being explored. The best of it assays 6½ dwt. for 5½ ft. These results are given as ascertained by a cross-cut at 39 ft. below the level. Good news is also to hand from the Sons of Gwalia where on the tenth level (880 ft. vertical) a cross-cut has cut the west lode and found 5 ft. of 11 dwt. ore. This lode has now been traced from the second to the eleventh levels, thus proving a large extent of stoping ground, as yet scarcely touched. In the bottom of this mine, on the 16th level and in a winze 300 ft. south of the shaft, the main lode is proving productive at a point further north than in the upper levels. For a width of 6 ft. the ore averages 11 dwt. per ton. The seventeenth level should cut this ore in about six weeks. Even the Lancefield mine sends encouraging news, for the sixth level shows 7 to 8 ft. of 12 dwt. stuff. At the same time the difficulty of treatment appears to look less formidable and it is expected shortly to be able to give the mill its full capacity of 10,000 tons per month.

At the Great Boulder Perseverance the new plant, rebuilt since the fire last November, has been started and a full resumption of productive operations will now follow. The discrepancy in estimates of ore reserve in the Associated Mines has been investigated by Mr. E. H. Liveing, who states that a reliable estimate is "impossible." We commend his courage. Apparently the trouble arose from the effort to average the poor ore from the main stopes with the very rich ore from a small pocket, which being finally exhausted, reduced the general average suddenly.

In the case of the Associated and the Golden Horse-Shoe we are informed on the best authority that the error in the estimates of ore in reserve was known to a few as much as six months ago in one case and nine months ago in the other. The obvious efforts to harmonize discrepant statements has been due to unsuccessful efforts to evade an inevitable crisis. In both instances the general managers are men of unquestioned probity and their errors are due primarily to the fact that both are metallurgists with a scanty experience in directing the underground operations of a mine. They were in the hands of foremen and surveyors, by whom they were misled. Undoubtedly at Kalgoorlie the complexity of the metallurgical annex has tended injuriously to belittle the fundamental importance of experienced control in the actual mining.

For some time the shares of the Great Fitzroy copper mine at Mount Chalmers, Queensland, have been depressed, much to the mystification of the shareholders and public, who

had previously been impressed by the excellent reports of great bodies of copper ore. That something was wrong was evident, though no statement was published. A note has now been issued by Bewick, Moreing & Co., the managers, announcing that Mr. W. J. Loring has advised an alteration in the plans. It appears that water concentration has been unsatisfactory and that the results claimed by the late superintendent cannot be substantiated. Accordingly the concentration mill has been closed, and all efforts are being devoted to pushing forward the construction of the flotation plant and sintering furnaces. In the meantime only one smelting furnace is in operation, working on crude ore.

Our Melbourne correspondent sends interesting information concerning developments at Broken Hill. He quotes Mr. T. Edgeworth David, one of the foremost of Australian geologists, who is opposed to the simple saddle-reef theory and lays stress on the deep-seated fissuring parallel to the eastern member of the big saddle formation. The Warden at Tanami reports favourably on that new goldfield in the Northern Territory. At present the 'dry-blowers' are doing best, as was the case at Kalgoorlie in the early days.

INDIA. — The Kolar group presents no notable feature this month, and the interesting news from India comes from Anantapur. It reported that prospecting work at the North Jibutil property belonging to the Anantapur company is yielding promising results, for at shaft No. 2, half a mile away from No. 1, the vein is found to assay 15 dwt. over 4 ft.

MEXICO.—From El Oro the most significant item of news is the finding of pay-ore on the main San Rafael lode at the 1300ft. level from the Somera shaft. The ore assays between 8 and 9 dollars for a width of 14ft. On the 11th level the San Rafael was barren. We note with pleasure that the annual report of the manager of the Mexico mine has been issued in the form of a circular fully a month ahead of the annual meeting. This promptitude in distributing information to shareholders is much to be commended. Owing to confusion of names it has been stated incorrectly that the Exploration Company is interested in the Furber oil enterprises. The purchase of the Buena Tierra at Santa Eulalia, in Chihuahua, was completed at the end of June by the Exploration Company of England & Mexico. Work is in progress under the direction of Mr. R. M. Raymond.

News from Pachuca indicates that the deeper development of the Santa Gertrudis is most satisfactory. The 17th level has now been extended for the full length of the ore-body, and the results fully confirm the estimates based on winzes sunk from the 16th level. A winze has been sunk 120 ft. below the 17th level and from it cross-cuts will now be extended. At the present time 7000 tons of ore is being treated in the Guadalupe mill and in March the new plant at the mine will be ready to treat 15,000 tons per month. Adequate power is now available.

Another Mexican gold and silver property is to be introduced in London. This has been acquired by the Associated Northern Blocks, one of the Landau companies working at Kalgoorlie that has arrived at a period when exhaustion has to be seriously considered. Mr. W. E. Simpson has been in Mexico for some time looking for mines, and that which he has recommended is at Zacatecas close to the Benito Juarez. It is an old mine and the ore is amenable to the modern cyanide process.

SIBERIA.—Progress at the Kyshtim copper mine is excellent, and the output is increasing. The figures for 1909 were 1100 tons, and those for June last 137 tons. The two new furnaces of the Washoe type with a capacity of 600 tons per day each are being built and should be ready in the late autumn. Owing to the large content of iron and sulphur in the ore the matte produced contains only 20% copper.

To obviate the necessity for further smelting in order to produce a higher grade matte, basic-lined converters are being erected on the Peirce-Smith system as used at Baltimore. The company owns deposits of magnesite suitable for the bricks. In fact, it is most favourably circumstanced in every way. The iron works belonging to the same estate supply all requirements in the way of castings; the gases from the iron blast-furnaces are used for generating electric power; the supply of wood for fuel is illimitable and the forests are carefully managed. Power is also obtained by making producer-gas from wood, and remarkable results are obtained in the way of calorific value. Another advantage is that the copper mines are close to the railway. When the new furnaces are at work the output of copper will be nearly 6000 tons per year.

Exploratory work in the Atbasar copper district is giving encouraging results; apparently the zone of sandstone impregnated with bornite, and its oxidation product, lies from 10 to 160 ft. below the surface and contains enough copper to be worked profitably over an immense area. The thickness of the deposit is from 2½ to 4 ft., averaging about 3 ft. Several shafts are being sunk, as a sequel to successful diamond-drilling. In addition to the flat deposit this district is traversed by nearly vertical sheer-zones, some of which contain rich ore. This feature is to be fully tested by cross-cutting.

The Spassky, which is also in the province of Akmolinsk, produced 224 tons of fine copper in June and 230 tons in May. About 15,000 tons of ore, averaging 18% copper, is accumulated at surface. In the mine the workings are restricted by the heavy character of the hanging wall. The deepest level is at 490 ft., where the orebody has been lately cut, showing 15 ft. of 14% ore. The ground between 490 and 350 ft. is virgin, and wherever tested will average over 25%. It is amusing to note that this small body of high-grade ore has been mentioned in the same context with the 'disseminated coppers' of Arizona and Nevada.

BRAZIL.—It is pleasing to note that the St. John Del Rey, a famous gold mine, is doing well, yielding 200,000 tons of 10 dwt. ore per annum. The deepest level, which is 4300 ft. vertical below the adit, or 4600 ft. deep in all, is yielding ore fully equal to the average, so that the life of the mine promises to be prolonged after the 1,000,000 tons in reserve are exhausted. Indeed the chief cause of anxiety as to the future is the heat of the rock; at the bottom workings the temperature is 100°F. and the lode is dry. The Morro Velho, as the mine is named, was acquired by the present company in 1830. From 1842 to 1867 the dividends totaled £896,500. Between 1882 and 1896 no dividends were distributed, owing to the collapse of the main workings, and the cost of sinking two new shafts, by means of which the mine became again productive in 1896.

CANADA. — Our Vancouver and Toronto correspondents refer to the Stewart excitement. The most trustworthy evidence as yet available is that of Mr. R. W. Brock, the Director of the Canadian Geological Survey, who speaks of the district as "attractive to the prospector." That is all that can be said as yet. We note that the quarterly bulletin of the Canadian Mining Institute contains a short article by Mr. R. W. Thomson on the Portland Canal mining district, for which Stewart serves as the port of entry. Apparently several promising prospects exhibiting low-grade ore, containing lead and copper, as well as the precious metals, have been opened up, but nothing that can be called a mine. However, the outcrops are wide and generous, so that possibilities of development are excellent. We note also that the *Canadian Mining Journal*, as might be expected, deprecates the sensational tales cabled to London. Passenger agents are attempting to profit by the excitement, which has lured many people to make a hasty journey to British Columbia.

Meanwhile equally hasty promoters have issued half-baked schemes inviting public subscription of capital, but it is all premature.

UNITED STATES.—A fresh crop of rumours concerning copper consolidations at one time helped the New York market, but this recurrent talk was more than balanced by the actual injury to grain crops by reason of the excessive heat; indeed the hot weather in New York and the cold rain in London illustrate our impressionability to diverse physical conditions, especially in the dog days. The collapse of the boom campaign and the urgent liquidation on Wall Street have checked confidence in the American market. Anxiety has not been lessened by the formation of a Bankers Emergency Association, suggesting fear of further serious trouble.

Several American companies are soliciting subscriptions in France and Germany. One of these is the Austin Manhattan, of Nevada, concerning which we can state that the quantity of probable ore available is wholly insufficient to give adequate returns on a capitalization of $10,000,000. Attention has also been invited to sundry oil promotions, on the faith of ludicrous statements advertised in our own daily Press. English people giving their money for such irresponsible enterprises are egregiously foolish. In every case the report of a reputable engineer should be forthcoming, and we do not hesitate to warn the public against placing any confidence in the untechnical opinions of worthy citizens, State officials, and fiscal agents.

COPPER.—It is estimated that the deliveries of American copper for the calendar year will amount to 342,210 tons as compared to 314,732 tons in 1909, when the total exports were 304,000 tons, against only 260,000 tons this year. From present indications it is anticipated that the surplus of metal in America at the end of the current year will be 24,000 tons as against 84,825 last year. During July the reported sale of 25,000,000 lb., or 11,160 tons, by the United Metals Selling Co. at a price of 12½c., or £58 per ton, helped the market, and was considered to foreshadow a reduction of output by agreement between the leading mining companies. The United Metals Selling Co. is an agency acting for the Standard Oil group; it is reputed to have been "holding the umbrella" for the smaller producers by purchasing copper on a weak market. Now that this protection has been withdrawn the realities of the economic position will be better realized. How great a part the Stock Exchange plays in copper production is illustrated by Amalgamated, which, even on a depressed market, is selling on the basis of a return to investors of 3⅛%. Of course, more money is made by a clique of speculators in kiting Amalgamated quotations up and down than in digging copper out of the earth.

The Copper Producers' Association reports that the production during July was 118,370,000 lb., a decrease of 8,849,000 lb. as compared with June, and deliveries were 116,115,000 lb., a decrease of 3,143,000 lb. The stocks increased by only 2,254,000 lb., as compared with increases of 7,960,000 lb. in June and 18,441,000 lb. in May.

SILVER.—At the end of July the market for this metal exhibited decided weakness, and the cash price fell to 24⅝ pence per ounce. It is said that the large holdings of one operator threaten the market and as the ultimate destination of this large accumulation cannot be foreseen a further decline is probable. The Indian Government is not likely to require silver owing to an increase in the reserve of currency. The bazaars, which are now the only regular consumers on a large scale, are inactive; they are taking about £35,000 of silver per week, while America alone is producing fully £250,000 per week. China has reduced her holding and is not in the market for more, except at low prices. The only encouraging factor is the prosperity of India, which is still the chief purchaser.

EDITORIAL

CANADA is much to the fore in these days, therefore it is a pleasure to meet men thoroughly representative of the greatest of the overseas dominions. On July 25 the President and Council of the Institution of Mining and Metallurgy gave a banquet at the Savoy hotel to Messrs. Frank D. Adams, Willet G. Miller, John B. Porter, George G. S. Lindsey, and H. Mortimer Lamb. The affair was mutually enjoyable and tended to tighten the bonds of goodwill uniting the Institution in London with the Canadian Mining Institute.

ON August 2 the King presented the Edward medal to 50 miners and engineers, who risked their lives in an effort to rescue their comrades at the time of the Whitehaven colliery disaster. Marlborough House was honoured by being the scene of the ceremony, when His Majesty pinned the medal on the coat of each of these brave men. Peace hath her heroes no less than war. The tragedies of industry make demands on a kind of courage at least as fine as that evinced in war and it is a mark of advancing civilization when the devotion to duty among civilians becomes rated as highly as that of the soldier or sailor in battle. The memory of Edward VII. is worthily honoured in the name given to the medal worn by true men.

A REPLY given in the House of Commons by the President of the Board of Education on July 25 exhibits an anomaly, for it was acknowledged that the Department of Zoology in the Imperial College of Science and Technology received £2700 for salaries during the last session while the Department of Mining, including mine surveying, received £1900, although the number of students in zoology numbered 28 as against 66 in mining. From this it is a fair inference either that money was wasted in one department or that a lack of it is hindering teaching in the other department. The fact is that the training of mining engineers for the Empire is conducted on a parochial scale. Other Schools of Mines exist in British territory, and even in England, of course, but the premier institution is the one dignified by a Royal prefix and a most un-royal endowment.

THIS ISSUE marks the end of the first year of this Magazine. A year is an insignificant part of a geological period but it is an appreciable fragment of human life, especially in these latter days when the pace has been so accelerated by mechanical invention. Thus twelve months suffice to include real progress in every form of enterprise, even journalism. The retrospect in this case is not displeasing, for, whatever our shortcomings, we are able to record a hearty support from every part of the world; indeed, the geographic distribution of our readers reflects the extraordinary expansion of the postal service and the pioneer energy of our people. Of course, we expect to do even better, for the main charm of technical journalism is an unattainable ideal, like successive mountain ranges that give repeated promise of an uninterrupted view. We thank those who have supported the enterprise: the shareholders, literary contributors, subscribers, and advertisers. London still continues to be the nerve-centre of the modern world, at least as regards the energies devoted to mining, and in London the best and most authoritative mining publication ought to be issued. That is our ambition; with continued assistance and support, it will be fulfilled.

IN A RECENT issue of the *South African Mining Journal* we note an interesting reference to the proposed establishment of an iron and steel industry in the Transvaal, and we appreciate the compliment of a reproduction of an article from this Magazine, even though our contemporary disguises the borrowing under the form of an imaginary interview with Mr. Donald F. Campbell, the author of the article in question. Of course, engineers do not like to appear in the pose of advertising themselves through the medium of interviews, however willing they may be to give technical information to technical journals. At least, that is, we are informed, the position assumed by Mr. Campbell. Further, the quotation of the article as a sequel to the announcement that the Union Government had accepted the proposals of Messrs. Walker and Campbell is apt to be misleading because the article by Mr. Campbell was written long before any tender was made to the Government, and even before the report by Mr. F. W. Harbord was published as a bluebook. At the same time it is a pleasure to record that the opinion expressed by Mr. Campbell in our January issue was almost identical with the official pronouncement of the Government expert. We trust that the new metallurgical departure in South Africa may be abundantly successful and prove to be the beginning of an important local industry.

ANOTHER association of engineers has been formed, namely, that of the "bona-fide independent consultants." Sir William Preece presided over the meeting held in July for the purpose of organization. The aim was "that the genuine consulting engineers should be distinguishable from those who were not genuine consulting engineers, but had trade interests." Here is room for a few useful definitions; what is a 'consulting engineer' and what is a 'trade interest'? The latter is too elusive for us, but the former is simple: a consulting engineer is an engineer to whom clients go for advice; it may be good advice or bad advice, the man may be unfit to give it, but if he is paid for giving such advice he is a professional consulting engineer. The next thing to do is to winnow the chaff from the wheat, and label the good consulting engineers, so that we may know where to find them. Unfortunately no known human agency is competent to fulfill this arduous task of selection.

DURING the past year, South Crofty, the most progressive of all Cornish mines, has been troubled with complaints from farmers relating to the emission of arsenical fumes. The company settled privately one or two claims, but last month had to meet an action in the county court at Truro. After seven days hearing, during which much expert evidence was given for the defence, the jury returned a verdict against the company, and Judge Grainger expressed entire agreement with their finding. From this evidence it was clear that the old flues and stack were not equal to the increased duty put upon them by the company. This view had virtually been anticipated, when the construction of additional flues and a new stack was commenced a few weeks ago. In our next issue we intend to refer to the evidence, for some of the views given as to the origin of the arsenic were, to say the least of it, unexpected, and deserve comment.

THAT enterprising newspaper *The Daily Telegraph* publishes a long letter from a writer who protests against the lack of enterprise and the poor methods of British manufacturers doing, or trying to do, business in the Colonies. He refers to the scant courtesy accorded to him as a visitor from abroad and the necessity for interviews with junior clerks and other employees unable to further the matter in hand. Evidently our Colonial critic was not used to the buffers employed by British

firms to prevent their being overwhelmed with business. He makes an unpleasant comparison with his experience in America, where a gratifying desire to meet him and to do business with him was exhibited by the firms on whom he called. The King's message to England to "wake up" should be inscribed in illuminated lettering on every British manufacturer's office. It so happens that we also are in receipt of a letter from an Englishman resident in Mexico, complaining that our countrymen appear to take little trouble to cater for the foreign trade. He wanted to order wire rope and steel wheelbarrows, therefore he turned to the advertisement in a technical journal only to find that the firm with which he had had previous dealings, and to which he wanted to give the order, gave a cable address—and that was all. The firm had no agency in Mexico and as our correspondent knew neither the amount of the freight-rate from England nor the import duty, not to mention the time required for delivery, he was compelled to turn to an American firm, in whose advertisement he found a reference to no less than six Mexican agencies. Thus the business that would naturally be given by Englishmen to Englishmen is turned elsewhere. It is only fair, however, to say that American firms advertising in British papers occasionally omit to give the name of their English agents. In these matters errors are not confined to our people, but it must be confessed that they are lacking in enterprise and disguise the deficiency with a steel-plated superciliousness that is fatal to success in an era of keen industrial competition.

IN a useful book on 'Ore Mining Methods,' by Walter R. Crane, we note a reference to the origin of the term 'glory hole.' It is stated that the name was given to big open-cuts "because of the large number of deaths of labourers working in and about them—the victims of falls were spoken of as having gone to Glory." This is about as ingenious as the idea that the term arose from the fact that the ore extracted was gloriously rich. Famous 'glory holes' are those of the Alaska-Treadwell and Combination mines, the first being an enormous quarry, while the latter is merely an open stope of ordinary dimensions. Size is not a factor, nor richness, for the Treadwell ore assays fewer pennyweights than the Combination yielded ounces of gold per ton. Nor is danger an element in the christening; it is true the Alaska-Treadwell open-cut has been marked by fatalities, but we are not aware that the small opening to daylight at the Combination was ever accountable for sending a miner across the range. No, the term did not originate in America; it is Scotch. Glory is a variation of 'glaury,' meaning filthy. A glory hole is a place for refuse, such as an ash-pit. On the earliest passenger ships, which were mainly built by Scotchmen, the quarters allotted to stewards were so wretched as to win for them the title of 'glaury' or glory 'hole.' Thus a pit into which rubbish is thrown is a 'glory hole'; for example, old open-cut workings not infrequently receive the discarded tin cans, old boots, scraps, and rejects from a mine-boarding house. Thus an open-cut became a 'glory hole.' The term denotes anything but glory, and it is only the application of it to cavernous openings productive of valuable ore that has given it a new and pleasanter significance.

ATTACHED to *The Times* of July 19 was a supplement of 96 pages devoted to the advertisement of Japan. The quantity of matter was too great for quality, hence most of it was of the character of a 'write-up' or 'reading notice,' resembling the recommendation that the young man brought from his mother—interesting to the family, but not conclusive. In this voluminious descriptive matter concerning Japan we found a page devoted to the mining industry. Apparently it was written by a native

possessed of a dangerous familiarity with the English language, for he speaks of "mat smelting in copper mines," which evokes the picture of a furnace underground fed by fuel in the form of mats collected aboveground. We are informed that "the method bears the name of *Shin-fuki-ho* or *Jamashita-fuki*." Excellent names, but one would have sufficed. Coal is an important mineral in Japan. "Several places also exist which produce small quantities of lignite." We wonder how they manage to exist; precariously, it would seem, for lignite is a low-grade fuel. The Mitsui company possesses "one large pump which pumps out ten tons of water for every ton of coal produced." Assuredly a wonderful machine. It had to be extraordinary, for the mine produces "over 1,500,000 tons of caking coal" and is on "the island which extends under the sea." Do all islands extend under the sea or none? "Copper is found blended as layers with iron sulphide," just as Japanese idioms are mixed with English until the refractory mixture provokes a headache. At the end of 1908 "the number of mines was 5,574, with an area of about 925,936 acres, but the mines actually worked during the year numbered 1997, with an area of about 397,933 acres." Note the carefulness of statement indicated by the repeated use of 'about,' although exact figures are given. That is a detail; but it is fair to ask since when has a mining industry been measured by the number of mines or the acres disfigured thereby? Yet we are asked to believe that "the mining industry in Japan may be considered quite promising." It is so considered by ourselves and others interested in the subject, but the belief will not be strengthened by the rigmarole published by *The Times*.

THE *Revista Minera*, the exponent of the Spanish mining industry, and the *Echo des Mines*, its French contemporary, have recently exchanged a lively correspondence on the employment of Spanish mining engineers by foreign companies operating in Spain. By law the Spanish government is in a position to compel the mining companies to employ a properly qualified engineer who shall be accountable for the safety of the workings. This representative reports on every accident and is held responsible for criminal negligence. Naturally the person selected by the companies to perform this function is a Spaniard in good standing and, as a matter of fact, the gentlemen chosen are usually high in the employ of the Government as inspectors and geological surveyors. Thus it has happened repeatedly that the official sent to investigate an accident has found himself dealing with one of his own superiors quite able to brush aside the inquisitiveness proper to the performance of an unpleasant duty. In other words, investigation has been blocked by graft. This has happened so often as to create scandal and has aroused a protest, not from foreigners, but from the younger Spanish engineers, who object to some of their own countrymen taking pay both from the foreign companies and the Bureau of Mines, thus receiving a salary at the mine while blocking promotion in the Government service. The protest, therefore, is not against the employment of foreigners, but against double dealing on the part of responsible native officials.

AT RAMPART, in the interior of Alaska, there is an alluvial mine that was 'floated' in Pennsylvania. In the prospectus the gravel was described as containing so much gold per *bushel*. This unit of measurement was well adapted to the comprehension of the farmers who were the chief subscribers to the issue. The incident reminds us of the story related by Mr. E. J. Dunn, now Government Geologist in Victoria, who went to Australia in 1851, at the height of the gold fever. On board the ship there were many who were going to the 'rush,' although most of them had never

seen a mine; these talked about collecting the gold in *quarts*. We have noticed that many old miners who, unlike the immigrants just quoted, know all about quartz, will speak of "them quartz" and "those quartz" as if it were the plural of 'quart.' After all, the unit of measurement ought to be proportioned to the quantity to be measured; "per bushel" might be inferentially more accurate than "per ton," if the quantity were small. Thus the statement of 1000 ounces "per ton" is misleading, because 1000 oz. stuff rarely occurs by the ton; for such cases the German *messerspitzevoll* would be more appropriate. When ore assays at the rate of 1000 oz. gold per ton it is nearer the fact to say that it contains half an ounce of gold per pound of ore; the first statement evokes the vision of a mass of golden material, such as does not exist; the second suggests a lump of ore of extreme richness. The surmise is more glittering than the fact, but the fact is the only safe anchorage for business.

Estimates of Ore.

The discrepancies in estimates of ore reserves and the consequent disappointments to anxious shareholders in several Australian mining companies call for comment. In some cases the managers may be to blame for errors, and in others the directors may be open to criticism for lack of frankness, but to us the chief lesson conveyed by a series of similar episodes is the misunderstanding of the real nature of all such estimates. We refer to ordinary gold mines, of course; in a coal mine, in a few copper and lead mines, and rarely, as on the Rand, in gold-bearing deposits of exceptional uniformity, it may be possible accurately to estimate the tonnage and contents of large masses of mineral, but in the case of most gold veins such estimates are only approximations. By reason of wider experience and greater care, by the employment of systematic methods and the aid of numerous checks upon error, it has been possible during the last twenty years to develop ore estimation into a task less hazardous and more rational than it was in the days when a few grab samples sufficed as the basis for a wild guess, which was made with one eye on the past production, and the other on the share market. But even the greater refinement of method has not obviated errors in the estimate of ore in a vein of irregular width and contents; it remains an unscientific performance, for the calculations assume more than one factor of uncertain value. In business, men cannot wait for the last word, and in the estimation of ore it is fair to say that perfect accuracy of valuation is only attained when the mine is finally depleted; in short, the final proof of the pudding can come only when it is eaten. This does not mean that no estimates are to be made until the mine is exhausted, but only that an estimate shall not be assumed to be an accurate measurement in cases where accuracy is impossible. We plead for sincerity: the sincerity of technical science. If the facts suffice for an accurate estimate, let it be made and transmitted to the shareholders without loss of time, but if the necessary data are insufficient, it is better to say so than to guess twice and divide by two. Also we deprecate a form of statement that suggests a refinement of method that does not exist, as when the directors of a company in a circular state that the reserve of ore consists of 174,788 tons averaging 32·259 dwt. per ton. Is the shareholder to be blamed if he infers a high degree of accuracy in a method of estimation that gives the contents in pennyweights to the third place of decimals and the tonnage to a single ton. Of course, the final detail of the figures is accidental; it would be less misleading to state that the reserve consisted of 170,000 or 175,000 tons averaging either 32 dwt. or even 1½ oz. per ton. The man who made the estimate, no matter how carefully, does not know whether the mine contains 170,000 or 175,000

tons; if his estimate is correct within a margin of 5000 tons he is doing well; and as to the grade of the ore, that will depend more on the manner in which it is stoped than on the way in which it was sampled. The fact is the modern engineer has been hoisted on his own petard; in the desire to introduce greater system into methods of ore valuation and mine appraisal we have over-reached the mark and are now burdened with a pseudo-accuracy that has brought its own revenge in discrepancies that have added greatly to the difficulties of directors. Another point is worth re-iteration: in the reports of companies we see occasionally a gleeful reference to the fact that the estimate of their engineer has proved too low, so that results are better than expected, or we read that the estimate of ore made at the time of purchase has since been demonstrated to have been an under-statement, permitting the company to buy the mine for less than it was worth. Such expressions of satisfaction are merely human; we do not criticize them, but we do deprecate the idea that an under-estimate is more praiseworthy than an over-estimate. As a scientific man the engineer is expected to ascertain the facts and to interpret them to laymen honestly and sincerely, he is not supposed to twist the facts to suit the financial schemes of anybody. If the facts indicate that a mine contains 200,000 tons of ore, it is as dishonest to say that it contains 100,000 as it is to say that it contains 400,000. Similarly if a mine is undergoing an interim inspection it is no more creditable to give an estimate that is too low than one that is too high, for while the latter may lead outsiders to become shareholders at an inflated price, the former may cause them to sell their holdings at an unnecessary sacrifice. An engineer examining a mine for a company, that is, for the shareholders, is expected to speak as well of the property of his clients as the facts warrant, but he certainly is not engaged to depreciate that property in an effort to safeguard his reputation by making an under-estimate. Thus we come back to the point that what is needed is the sincerity of science: to look squarely at the facts and interpret them impartially. If a mine, such as most of those on the Rand, affords ample data and exhibits such regularity of structure as to minimize the uncertainties that enter into every mining problem, then let the engineer make his estimate in exact terms, but not in terms of decimals that suggest impossible refinements of sampling and measurement. If, on the contrary, as at Kalgoorlie, a mine contains orebodies irregular in structure and extremely variable as to gold contents, then let the engineer make an approximate estimate in round figures and state that the facts do not permit him to be more precise, and in that case assuredly he must not disguise vagueness of appraisal by a statement clothed in fictitious details. Mining should be scientific, but when scientific accuracy is impracticable it is not necessary to disguise the lack of it by humbug.

Efficiency of Concentration.

In our last issue we gave an outline of Mr. Theodore J. Hoover's ingenious theorem whereby information relating to the efficiency of concentration can be obtained without directly measuring the amount of ore treated or concentrate produced. At the time we said that this method of calculation had many applications, details of some of which we hoped to publish later. We have pleasure therefore in drawing attention to Mr. Hoover's article appearing in another part of this issue. It will probably startle most engineers to find that full details of the production and concentration at a mine can be deduced by an outsider, without a reference to the records. An observer can see how many buckets or cars of ore are sent to the mill and how many bags of concentrate are shipped. A manager as a rule does not allow an outsider to sample the ore, but probably is glad to tell the value of

his concentrate; he does not see any particular reason for preventing a visitor from sampling the tailing, if the assay-value of the ore is kept secret. If therefore an outsider can estimate the amount of ore and concentrate, and can obtain the assays of the concentrate and tailing, he can deduce by Mr. Hoover's method the assay-value of the ore and the percentage of recovery. He becomes a technical Sherlock Holmes.

Many mines publish figures relating to the quantity of ore treated, and the amount of concentrate produced, together with assays of both. Let us suppose that an outsider wishes to purchase the tailing-heaps. As a rule he goes to the owners, and the two parties to the transaction then survey and sample the material. The buyer, however, would be in a much better position, if he knew all about the contents of the heaps beforehand. By Mr. Hoover's method he can deduce complete information about the tailing without access to them.

The formulæ simplify many calculations that hitherto have proved laborious. For instance, the calculation of the average metallic contents of a mixture of various tailings, when three metals such as lead, zinc, and silver are present, is a long and tedious process. Mr. Hoover shows in his article how the time occupied by the calculation can be reduced from two hours to ten minutes, and with greater accuracy. There are other instructive applications of this theorem given in Mr. Hoover's article and we recommend engineers to read and study it carefully.

Tanganyika Concessions.

In an expansive moment Mr. Robert Williams allowed himself to be interviewed and made several statements concerning the prospects of the Tanganyika Concessions. This gigantic copper enterprise is making progress, for the railway is to be completed in October and the huge plant is to be erected forthwith, that is, construction is about to begin. Mr. Williams forecasts an output of 1000 tons of copper per month at the end of this year, whereas in December last he told the shareholders that the output twelve months hence would be 2500 tons of copper per month, while at that time the company's metallurgist stated that the plant about to be erected would extract 1500 tons of copper per month. Here are varying estimates, provoking the questioning of Mr. Williams' further prediction that within three years from the date of the last meeting of shareholders the Tanganyika Concessions would be producing 60,000 to 90,000 tons of copper per annum. Many years will elapse before such estimates are proved or disproved; the plant will not be erected for two years, and reasonable rectifications may consume a year more, so that the day of reckoning or congratulation is a long way off. Meanwhile we repeat the criticism made at great length last January, that a venture involving the investment of £7,000,000 under unusual difficulties and in the heart of Africa is being undertaken without adequate technical advice. The criticism will hold whether success or failure ensue. We hope that the enterprise will prove successful, for the sake of the shareholders, the development of Africa, and the repute of mining as a legitimate industry, but we question the methods employed and the recklessness exhibited by those in control.

We note, with amusement, that the correspondent of *The Financial News* who interviewed Mr. Williams has now organized a party of twelve shareholders to go to the Star of the Congo mine, in order "to look into the business proposition and verify the statements of enormous wealth." This expedition will differ from that of the famous Duke of York mainly in the length of the journey, for it goes unaccompanied by an experienced mining engineer or metallurgist. Of all comic performances in real life none is more absurd than the visits of untechnical shareholders to mines.

The gentlemen in question will bring back vivid impressions of the Victoria Falls, of a country of magnificent distances, and of copper-stained masses of rock, but their opinion of the work of the Tanganyika enterprise will be as authoritative on their return as it is now, and no more. The organizer of the expedition is a journalist, and therefore we may expect sundry interesting descriptions, but that is all. A mine can only be appraised by a mining engineer, and a reduction works can only be criticized intelligently by an experienced metallurgist. We are sorry to see that the lack of technical advice is to be supplemented by an excess of untechnical opinions.

Standardization.

We note with interest that a sub-committee of the Chemical, Metallurgical and Mining Society of South Africa has issued a report recommending the acceptance of select forms and spellings of technical terms, with a view to standardization. Of course, we are glad to see this evidence of interest in the subject, as a further proof of the tendency to apply forethought to technical writing in English. Recently a paper was read before the Institution of Mining and Metallurgy, in London, by an editor and engineer conspicuous for his advocacy of reform in these matters. Undoubtedly the technical societies in London and Johannesburg can do useful service by making an earnest effort to introduce system into an important department of engineering work, and it is probable that their service in this regard will be most effective if they act conjointly. It is a pity that the metropolitan Institution allowed the South African Society to lead the way, as has now been done by the issuance of a printed circular, but it is not too late for co-operation. It would be well if the editors of periodical mining publications, such as the *Mining and Scientific Press, Engineering and Mining Journal, South African Mining Journal, Canadian Mining Journal,* and *Australian Mining Standard,* were to express their views and promote harmony of practice in the usages incidental to technical writing. While the engineering societies can do much to diminish the chaos and to crystallize the customs prevailing in the literature of technology, the court of last resort is not the intermittent bulletin of the amateur writer but the regular issue of the periodic Press as conducted by the professional journalist. To be effective any reform, such as that advocated by the South African Society, must be supported by those in control of the periodical literature of the day—a literature the ephemeral nature of which is compensated by its iterative quantity. As an influence upon the use of current language the newspaper is more powerful than the book, and the mining journal farther reaching than the transactions of an association. Usage is determined by users; the members of an engineering society employ occasionally the medium of printed writing, which is the daily weapon of the journalist. The occasional pastime of the amateur is the life-work of the professional. Yet, in this, as in other matters, the amateur may have nice perceptions such as are apt to be blunted by the daily familiarity of the man who makes his living by the pen, therefore it is well that the intermittent, no less than the persistent, writer should be consulted, and that the two of them should unite in an effort to furbish the weapons of scientific expression. We hope that the Institution in London and the many-named Society at Johannesburg will unite in the good work, and obtain the whole-hearted support of those whose boast it is that the pen is mightier than the pick.

We note that at the recent annual meeting of the Australasian Institute of Mining Engineers, it was stated by Mr. F. Danvers Power that "different terms were being used in various parts of Australasia to signify the same things and processes in mining." On motion, it was resolved to ask the Council to take

action in the matter. Let the good work continue. It is needed.

Capitalizing Romance.

Almost anything can be capitalized in these days, even romance. Indeed for some forms of speculative enterprise an iridescent halo of sentiment is imperatively necessary in order to magnify the attractions placed before those who are impatient to become rich. One way to achieve this purpose is to buy shares that others will purchase at a higher price; it does not matter whether it be a rubber plantation or an oil well, timber or gold. If a company be organized and scrip created under regulations by no means oppressive, it is possible at short notice to supply all the essentials of a *petits chevaux* kind of gambling, in which the successful deem themselves clever and the unsuccessful hope for better luck next time. In our last issue we referred to the 'rush' to Stewart and gave all the information then available concerning the supposed new goldfield in British Columbia. On the next day the daily Press contained the advertisement of a prospectus issued by the First New B. C. Goldfield, a company organized with a capital of £100,000 in a million shares of two shillings, of which 600,000 shares are allotted to the vendor "in part payment of the purchase consideration." The usual array of bankers, solicitors, brokers, and auditors appears on the prospectus, besides the names of five directors none of whom are known to us as possessing any special knowledge concerning the business of mining. One of them, it is true, is a director of a South African company, but that signifies little. No mining engineer's name is given, although the services of a properly qualified advisor are more essential to such an enterprise than the solicitors, brokers, etc., etc., whose names appear with weary iteration on so many prospectuses. It appears that a Mr. Heming 'grub-staked' some prospectors who located four claims in the Bitter Creek district, near Stewart, and that one, but only one, of these four claims now constitutes a basis for the company under review. Instead of a report the prospectus quotes a rapturous paragraph from a letter addressed to the vendor by Mr. Heming. The latter gets 360,000 shares out of the 600,000 shares allotted to the vendor, who also receives £10,000 in cash, and £10,000 in cash or shares. And all this for a location certificate to a claim in British Columbia on which the only available information is the unconfirmed statement of an excited prospector. Of course, prospectors do not always exaggerate and it is quite possible that the "most wonderful find" may "surprise the world for richness and magnitude." But it is highly improbable, all the same. The bigger the statement the stronger is the proof needed. Mention is made of "samples" that were "assayed"; why are the results not given? Mr. Heming "believes" that "the property will produce a very large return"; to whom? Is the 'belief' of an unknown person to be capitalized for £100,000 and are the unverified exaggerations of an honest prospector to be minted into sovereigns by the turn of the wrist here in London? It is absurd; and this absurdity receives a finishing touch when the prospectus proceeds to quote extracts from the references made to the Stewart excitement in the daily Press of London, as if that were an argument, to Londoners! A sensational paragraph from the *Daily Mail* or the *Evening News* is to be taken as proof of the value of a gold mine in British Columbia. What a satire on journalism and finance! Yet we read in the market report for July 13 that "First New B. C. Goldfields were dealt with on the basis of 3d. to 6d. premium." Thus a location notice stuck to a post in the far-away mountains of British Columbia is metamorphosed into a share premium on Throgmorton Street. Great are the resources of civilization.

After the above was written the prospectus of the British Columbia Mines, Land, and

General Finance Company appeared in the daily Press. This also is open to serious criticism. The prospectus is prefaced by half a dozen extracts from the columns of newspapers, such as the *Daily Mail*, *Daily Express*, and *Daily Chronicle*, speaking confidently, and, it seems to us, recklessly concerning "the great gold strike." Then follow a number of general statements concerning the mineral resources of British Columbia, taken from an old official report. What has all this to do with the real matter in hand, which is the question of subscribing for shares in a corporation formed "to transact business as a mining, land, and general finance company" in British Columbia? If sincere, the prospectus is pitiable; if not sincere, it is bunkum. We prefer to believe that it is well intended but misdirected, for no mining engineer's name is included in the administration. Again we ask what do the bankers, auditors, brokers, and secretary know concerning mining and what guarantee do they offer that the shareholders' money will not be wasted, honestly, of course, but none the less fruitlessly. Will anyone but a fool buy land or house property without the advice of an expert valuer; does a sane man put to sea in a boat manned by brokers and auditors; should a sensible man embark in a mining enterprise without the guidance of an experienced mining engineer? It is time that the public recognized a pathetic fallacy.

Disseminated Copper.

The latest bulletin of the Mining and Metallurgical Society of America contains a record of the discussion at New York and San Francisco on the interesting subject of the 'porphyry coppers,' meaning thereby the mines exploiting large masses of low-grade ore in which copper is minutely disseminated. In the case of the first mines of this type developed in Utah and Nevada the rock thus enriched happened to be a monzonite porphyry but more recently similar masses of ore in Arizona have been uncovered in highly altered schist. In fact, the existence of mineralized porphyry near well defined veins of copper has long been known, but such occurrences had no economic value until mining and metallurgical methods were evolved for treating big quantities of material at a cost formerly deemed visionary. Whatever the rock now impregnated with copper, it is believed that the source of enrichment was an igneous intrusion of granite or monzonite porphyry, that is, a rock of coarse texture and deep-seated crystallization. Evidence favours the idea that mineralized areas are to be found along the margins of intrusive masses of porphyry and in the adjacent rock near the contact. Such orebodies consist essentially of rock that was originally impregnated with iron and copper pyrites, and subsequently enriched by descending solutions, which robbed the overlying formation, in places now eroded or else surviving as an impoverished gozzan. The copper leached from the superficial zone has usually been re-precipitated as chalcocite and sometimes as native copper, coating the pyrite of the deeper zone, until the average copper content has been raised from 1% or less to 2% or more. Mineralization has been accompanied by decomposition, so that the black sooty chalcocite is found filling minute cavities in a kaolinized porphyry that is easily mined. The depth to which this secondary enrichment has progressed will depend upon local conditions, particularly those affecting the position of the water-zone; in arid regions, as in Arizona and Nevada, the depression of the lower limit of ground-water favours the downward penetration of oxygenated solutions and thereby extends the range of secondary enrichment. Thus an ore-bearing zone is differentiated as a thick undulating sheet, usually covered by an overburden of impoverished rock or blanketed by later flows of lava that have checked erosion and at the same time obscured the evidence for which the prospector seeks, so that drill-holes or shafts are required to obtain the proof of a

profitable mining zone under the barren surface.

In turning from the geological to the mining and metallurgical aspects of the subject, we find an equally decisive application of science to industry. The success of the disseminated copper mines is one of the triumphs of modern engineering. The Detroit and the Arizona copper companies, at Clifton and Morenci, in Arizona, were the first to turn from rich smelting ore to low-grade concentrating ore. The experiment, though successful, did not attract attention until the Utah Copper Company essayed to do similar work on a larger scale. Then the Boston Consolidated, also in the Bingham district of Utah, commenced to exploit a copper-bearing porphyry. Meanwhile at Ely, in Nevada, a large deposit of low-grade monzonite had been carefully tested in mines that had failed when worked for high-grade ore only. The success of the experimental mill of the Utah Copper Company at Bingham proved that such ores could be concentrated satisfactorily and this event facilitated the effort to finance the Ely group of mines under the name of Nevada Consolidated. The use of the churn-drill for sampling large areas, the adoption of the steam-shovel to remove the barren overburden, the application of the caving method for underground mining, the development of a systematic scheme of treatment in large mills, and the cheap roasting of the resulting concentrate, have all been important factors in stimulating the wonderful results that have so seriously affected the copper market. In 1909, the Utah Copper, Boston Consolidated, and Nevada Consolidated reached the productive stage and in that year contributed 50,000 tons of copper or 5% of the world's total output. These three companies are making copper at the rate of 75,000 tons per annum. Other mines of the same character have been started, so that, according to recent estimates, the disseminated copper group may be adding 200,000 tons of metal to the available supply in 1912. This is as much as the total world production in 1883.

It is obvious, therefore, why the metal market is intimidated by this new source of copper. The enormous scale of operations and the successful reduction of the ore have enabled copper to be won at a cost previously only touched by one or two exceptionally fortunate mines in the Lake Superior region, where the copper exists in the rock as native metal and is therefore readily extracted. The 'disseminated coppers' are synonymous with 'cheap coppers,' the metal being placed on the market at a total cost of from 8 to 9 cents per pound, equivalent to £40 per long ton. In 1909 the Nevada Consolidated stripped 1,093,307 cubic yards of overburden and mined 1,082,909 tons of sulphide ore, producing 1,065,387 tons of dry ore averaging 2·34%, and yielding 34,527,823 lb. of copper at an average cost of 7½ cents per pound, as compared to 13 cents, or £60 per ton, the mean price of copper during 1909. In 1909 the Utah Copper produced 51,749,233 pounds of copper from 2,674,271 tons of ore, averaging 1½% and yielding 0·96%, at a cost of 8·742 cents per pound of copper. These statistics are sufficiently eloquent. Meanwhile the Boston Consolidated has been amalgamated with the Utah Copper, making a mine with 170 million tons of 1½% ore; while the Nevada Consolidated, after amalgamation with Cumberland Ely, has 32 million tons of 2¼% ore; the present rate of production is 100,000,000 lb. in one case and 65,000,000 lb. in the other, but the output is to be augmented to 140,000,000 lb. in the one case and 70,000,000 lb. in the other. But this is not all. The Ray Consolidated, Miami, Inspiration, and Keystone in Arizona, the Chino in New Mexico, the Greene-Cananea in Sonora, and the Braden in Chile are giving promise of an enormous production. The Miami is credited with 14,000,000 tons of 2·7% ore, the Ray with 67,000,000 of 2·1%, the Chino with 18,000,000 tons of 2·6%, and the Keystone, according to the latest report, with 2,000,000 tons of 2·36% ore. All this represents an enormous application of labour and

GENERAL VIEW OF COPPER FLAT, ELY, NEVADA.

STEAM-SHOVELS IN OPERATION AT ELY, NEVADA.

skill, energy and optimism, machinery and capital.

Other mines still in the prospect stage give promise of ability to add to the rapidly increasing production from this type of copper deposit. Naturally the remarkable success of two or three enterprises has stimulated financial interest and excited public speculation in similar undertakings. And not without incurring risk through erroneous inferences. Not all of them have benefited from such careful investigation as preceded the work done by the promoters of the Utah Copper, Nevada Consolidated, Miami, Ray, and Chino mines. The ease with which these blanket deposits can be drilled has led to confusion of ideas as between the proof of a large tonnage and the ascertainment of the average content. The second is the much more difficult task, and only to be achieved by the exercise of the maximum skill and care. Exploration by drilling has yielded results that have been confirmed by stoping, but only in cases where extreme precaution preceded the simple arithmetical exercises involved in statements concerning estimates of millions of tons of ore. To ascertain accurately the average grade of the ore in such cases is not easy; even a slight error may be fatal, for the margin is small. Again, the success of the milling and smelting is inferred in some cases without making working tests. It is manifestly absurd to assume that all ores of this character are so much alike as to be equally docile to the metallurgist, and it is childish to take it for granted that the cost will be 8 or 9 cents per pound of copper, simply because one or two exceptionally favoured companies have achieved such a result. Moreover, the removal of overburden, relatively inexpensive during the youth of one of these mines, becomes increasingly costly as the opening is enlarged. The ratio of ore to waste becomes less favourable as the slope of the sides of a big open-cut has to be flattened, unless the deposit happens to occupy the apex of a hill. At Rio Tinto the effort to work with steep slopes has failed and it has become necessary to adopt an angle so flat as to entail the removal of a mass of overburden three times as large as in the early days. Indeed the great mine in Huelva is full of suggestion to the younger enterprises in America. Rio Tinto has 150,000,000 tons of 2¼% ore and is working in terraced excavations 600 feet deep. The engineering difficulties are steadily increasing and while, of course, they will be overcome, the cost of extraction is bound to reflect the added burden. Thus while the huge open-cut mines in Nevada and Utah may start with an extremely low cost of mining, once the first slice of overburden is removed from the ore, it is inevitable that the deepening of the mine should necessitate an additional expense not included in the first estimate. But another factor, even more portentous, is the market for copper. These low-grade blanket mines were started when their product competed only with that from the high-grade vein mines, when the metal of the 'disseminated copper' deposits was won cheaply, and the supply of copper was increasing no faster than the demand. It took five years to bring the leaders to a productive stage; less time will be required for half a dozen other big mines of the same type to begin contributing to the world's supply of the metal. They no longer compete only with the companies that produce copper for 10, 11, and 12 cents per pound; they compete with one another. In other words, the increasing proportion of cheap copper must inevitably reduce the price of the metal, even if some of the high-cost companies cease operations. Consumption of copper may increase, and it probably will, steadily; but production from disseminated copper deposits will certainly increase rapidly. Between these two factors the market will oscillate, and as the second appears more powerful than the first, the result will be to depress the price of copper. It seems inevitable.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

VANCOUVER.

The Boundary district exhibits excellent progress generally. The Granby company is mining and smelting about 22,000 tons per week; the Snowshoe mine of the Consolidated Co. is only shipping about 1800 tons per week, as this concern is giving a lot of attention to its recently acquired No. 7 mine, with a view to putting it on a productive basis. The B. C. Copper Co. is sending out over 4000 tons per week from its Mother Lode mine and nearly 400 tons per week from the Oro Denoro, with a like quantity from the Jack Pot, at Wellington. This company will be taking ore from the Rawhide mine of the New Dominion Copper Co. as soon as the improvements at the Greenwood smelter have been finished, at the end of July.

The Columbia Coal and Coke Co., which took over the holdings of the Tulameen Coal & Coke Co., is about to float a bond issue of $500,000 to provide capital for the development of its coal tract near Princeton. A modern plant is to be installed and within a year the Company hopes to be producing about 500 tons of bituminous coal per day. In the not distant future it is the intention to work up to a production of 1500 tons per day. George L. Fraser is in charge of this work, backed by Winnipeg capitalists.

Slocan-Kootenay.—Shipments of ore and concentrate have been steady, the old mines like the Rambler-Cariboo, St. Eugene, Richmond-Eureka, and Standard producing a large tonnage, while the Consolidated Co. has opened up the Sullivan, Molly Gibson, and Queen Victoria mines. The lessees of the Silver King, near Nelson, however, have ceased work, after shipping nearly 1600 tons of ore from the mine this year. It seems that the cost of pumping water was too great, and on this account they have not worked the lower levels. The concentrators of the St. Eugene, Van-Roi, Whitewater, Queen, Granite-Poorman, and Nugget mines are treating 4955 tons of milling ore per week.

New strikes continue to be reported from the Sheep Creek district. The latest strike is on the Devlin group, on the same hill as the Nugget, Mother Lode, and Clyde-Belt claims. The vein uncovered is 14 ft. wide and assays $9·80 per ton, while a 2-ft. streak is said to run as high as $103 per ton. Six men are at work. Development work is being done on the Clyde-Belt group, while four 3½ in. machine-drills are in use for blocking out ore in the Mother Lode mine. At the Nugget hand-labour is employed, but it is hoped to put in a power-plant shortly. The Queen mine, across the valley, is equipped with a 20-drill compressor, power-driven. Work is going along quietly here just now as a sale is pending, but it is said that greater activity will ensue when the deal is concluded.

Hauling Machinery to the Mines.

Another significant sale of mining property was made in Sheep Creek district last week when the Eureka group of four claims was sold by Salmo men to Vancouver capitalists. The property adjoins the Kootenay Belle, which has been a good producer and controls both water-power and timber. Hymann & Van Houten have taken over the property at $55,000, of which 10% has been paid. Seven veins traverse the property. The last work done was 25 ft. of tunnel on three feet of ore, which averaged $25 per ton. It is stated that the Company now holding the property will begin immediate development and intend to install a 10-stamp mill, as the ore is 55% free milling.

Railway construction is a promising feature in south-eastern British Columbia. Work has been started on the Kootenay Central railway, which will open up the rich Windermere district, and the country from Golden, on the main line of the C. P. R. to Elko on the Crows Nest line, of the same railway. A contract has been let for the extension of the Kettle Valley railway; the first section covering the portion between Merritt, in the Nicola Valley coalfields, to the headwaters of the Coldwater river. James J. Hill is said to be behind this move, which is forcing the Canadian Pacific to extend its line from Midway to the Coast over the Hope mountains. This will mean, in a year or so, two outlets from the Boundary district to the Pacific.

Stewart.—Seven miles of the big lode on Bitter Creek, near Stewart, at the head of the Portland Canal, have been staked, right up to the glacier, in fact. The strike does not seem to be as rich as first reported but it is valuable and there is a mammoth body of ore. More recent assays show $5·20 to $8·80 per ton in gold on an average. A number of the prospectors have left Stewart and gone to Alice Arm district, where strikes have been made of $30·20 gold ore.

TORONTO.

Porcupine.—The Railway Commission, representing the Provincial Government, has refused to recommend the extension of the Temiskaming and Northern Ontario railway system into the Gowganda and Porcupine mining districts. For some time the mining interests have been urgently pressing for railway facilities and the Commission has given the question careful consideration, but now concludes that as the value of neither of these districts has yet been proved it would not be justified, from a strictly business point of view, to recommend these extensions. No doubt the complete failure of Larder Lake was not without its influence in this decision. Despite all drawbacks, however, Porcupine continues to attract speculation. Another large interest has just entered the field. D. Lorme McGibbon, president of La Rose Consolidated, and Frank Armstrong having acquired the Bruce claims, 17 in number, which will be developed on a large scale.

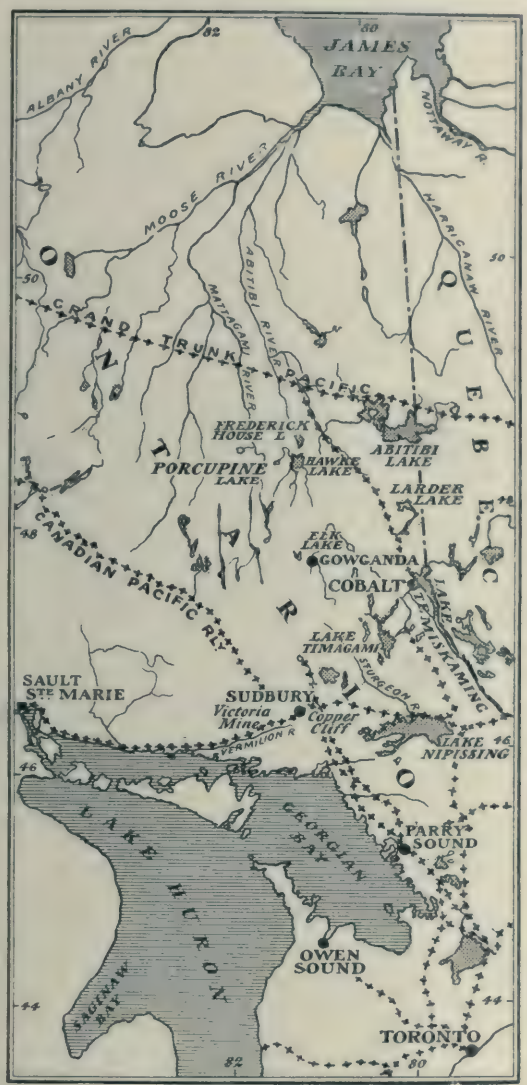
R.W. Brock, Director of the Canadian Geological Survey, has issued an instructive report on the Porcupine gold area, which he recently examined. He states that a wild boom appears imminent, prices of claims being far above any determined value. About 9000 claims have been staked, the great majority of which are worthless. But there are some really good-looking prospects; quartz is remarkably widespread, and visible gold has been found at numerous and widely separated points. He states that the gold is found in any of the rocks and in all manner of forms. There are well-defined veins, large isolated masses, called 'domes,' and numerous irregular stringers which may swell in places to large masses. The quartz contains many inclusions of altered country rock, in which pyrite is plentiful, and the gold, often coarse, is distributed in the same way as the pyrite, with which it is often closely associated. A little galena, blende, and chalcopyrite may also be present. The leading properties at present are the Timmins, Dome, and Foster. The Timmins is well equipped, with three shafts, one down 90 ft. with a 12 ft. vein from which fine ore yielding free gold is being taken. The ore looks as well at the bottom as on the surface. The Dome is under vigorous development and two large quartz masses 60 ft. wide and of considerable length are being opened up. Diamond-drilling is being undertaken to test conditions in depth. The Foster has a belt of iron carbonate filled with transverse masses of quartz, containing carbonate inclusions in which sulphides and gold have been deposited. The lode has been traced for half a mile and varies in width from 6 to 20 ft. Mr. Brock regards it as fortunate for the camp that a number of strong interests have taken hold of it in the initial stage, ensuring intelligent development and a thorough testing of the promising prospects.

The country around Great Pike Lake, 40 miles southwest of Porcupine, is attracting a number of prospectors, gold having been found in quartz veins traversing granite and schist. Some samples brought to Porcupine show free gold.

The Timmins mill at Porcupine, was started on July 20, the returns being stated at $300 per ton. Finds of large lumps of rich ore are reported. The Timmins Syndicate has ordered a 30-stamp mill to be built as soon as possible, to enable them to handle about 200 tons of ore per day.

Cobalt is maintaining shipments well, and the proportion of concentrates in the consignments is steadily increasing. The directors of the Hudson Bay have decided to erect a concentrator with 20 stamps and a capacity of 80 tons of ore per day. This will make the fourteenth concentrator in the district. The largest shipment of silver bullion hitherto made was sent out on July 11; it consisted of 35 bars from

the O'Brien, containing 33,500 oz., and 26 bars from the new cyanide plant of the Nova Scotia containing 26,700 oz. The Wyandoh mine has made its first shipment, namely, 24 tons, over half of which was high-grade ore. A new vein lately uncovered south of the No. 1 promises well on the surface and is being approached by



Northern Ontario. Showing the new mining districts.

cross-cutting. Several strikes have been made on the Trethewey, the latest being a 2 in. smaltite streak found in driving on the 150 ft. level and carrying about 5000 oz. silver per ton. The winze on the Little Nipissing, now down on No. 2 vein 75 ft. from the 155 ft. level, is to be sunk 50 ft. further. Two veins at the bottom of the winze have united to form a large body of ore. A rich 4 in. vein has been uncovered on the Nipissing in the course of surface development. On the Lawson property of the La Rose Consolidated a new vein of a promising character has been found in the west corner. A good find also has been made on the Peterson Lake, consisting of a 5 in. vein of smaltite carrying native silver in the south cross-cut on the 200 ft. level. A rich orebody has been struck on the 100 ft. level of the Crown Reserve; the ore is 6 in. wide and runs over 6000 oz. silver. A statement covering the first half of the year gives the value of shipments from this mine at $709,569 and the profits at $536,064, of which $530,644 was paid in dividends.

Gowganda.—The Bartlett mine in this district, once prominent by reason of extensive advertising, has passed into the control of a syndicate headed by J. R. Carter. The 300,000 shares remaining in the treasury will be taken by the large holders at 25c. to raise funds for resuming operations. The Millerette continues to make shipments, having sent out 283 tons this season.

Stewart.—Mr. Brock of the Geological Survey speaks favourably of the prospects in the Stewart river district, regarding which some highly extravagant reports have been sent abroad. He said "I think it safe to say that while it is not yet a proven or established mining camp, it is the most promising district opened up in British Columbia since the boom a decade ago in the southern part of the province."

Stealing Ore.—During the last session of the Canadian Parliament the law regarding the stealing or unlawful possession or ore was made more drastic. Hitherto such theft has been an offence difficult of detection. The Act as amended provides a penalty of two years imprisonment for anyone having ore or partly smelted gold or silver in his possession and refusing to account for it satisfactorily. The first conviction under this provision was made in July, when a foreigner named Alec Kubi, found with 14 pounds of high-grade ore from the Nova Scotia mine, received a sentence of six months imprisonment.

Coal.—The summary report of the Canadian Geological Survey just issued, records the discovery by D. B. Dowling of a new coal basin in Alberta, leading north from the Saskatchewan to the source of the McLeod river, a distance of over 60 miles. A coal-bearing horizon of smaller area east of the Bighorn range was also located. D. D. Cairnes has discovered some coal seams in the Wheaton River district near White Horse, in the Yukon Territory.

JOHANNESBURG.

Exhaustion of Mines.—The experience of the Bonanza, and more recently of the Geldenhuis Estate, has demonstrated the danger of attempting to predict with precision the time limits of a mine's profitable production. What the pickings in the Geldenhuis Estate have been worth to the Geldenhuis Deep, of which it is now an inseparable part, will only be known to a few. Another mine that is reaching the stage when its life may be estimated to a half-year is the Treasury, which is controlled by one of the few small outcrop companies retaining individuality. The mine has been paying dividends since 1892 and has distributed in all nearly half a million. The remaining ore is considered enough to feed the 60 stamps and 1 tube-mill (the third tube-mill, I believe, to be started on the Rand) for another two years. In the old Rand mines there is always a lot of recovery work to be done—winning pillars, 'taking up' hanging and foot, and regaining various sweepings and pickings—for which no definite tonnage estimate could be made. Engineers wisely do not commit themselves deeply in determining this uncertain factor in the prolongation of lives; hence we often note a period of dwindling production beyond the official pronouncements. In the case of the Treasury, however, the Chairman's statement does not hold out much hope of postponing the "last blast" beyond the two year estimate.

Robinson Deep.—The substantial improvement in the profits recorded by the Robinson Deep up to March and April have been the subject of frequent favourable comment and although attempts have been made to attribute the improvement to fantastic systems of record-keeping, it must be fairly acknowledged that the advance was due almost directly to the skilful management of G. D. Leslie, before his promotion to the head office of the Consolidated Gold Fields. Good management was needed at a critical period and it was provided. It is indeed regrettable to see the credit due to the personal influence of that good management weakened by such a declaration as the following, in the company's annual report: "In November, 1909, owing to a system of sampling adopted prior to that date, a method of stoping was introduced which aims at the mining of pay reef widths only, the result being an increased profit per claim." Readers unacquainted with local phraseology must not imagine that their inability to fathom this statement is due to ignorance of our dialect. The only apparent interpretation is that prior to November 1909 stoping-widths were excessively wide in relation to the width of profitable ore and that there was wasteful mining; also that after November 1909 better underground management prevailed and that close attention was paid to the narrowing of stopes, as upon every well regulated mine upon the Rand. Whatever the sampling system, it will demonstrate whether some of the 'reef' bands included are unprofitable or whether some of those uneconomically left in hanging or footwall are profitable. This information is invariably provided by the sampling returns of every properly managed mine on the Rand, where the sampling of each stope is accomplished monthly as a matter of course. If, therefore, the Robinson Deep only discovered the value of careful and systematic stope-sampling in November 1909, the less said about the matter the better. The excellent advance made by the company, owing to good all-round management, has been one of the bright features of the past year and it is to be hoped that the drop in May and June is not the beginning of a serious relapse. Comparative figures are as follows:—

Month.	Profit.	Month.	Profit.
October 1909	£21,806	March 1910	£30,806
November....	22,394	April.....	30,189
December....	28,071	May.....	28,725
January 1910	28,121	June.....	26,182
February	28,242		

If a jest is pardonable in the face of this table, which reveals such admirable improvement in the position up to April last, it may be mildly queried if the set-back in profits for subsequent months will be explained by the sickness of an assistant sampler and a regrettable slipping of a number in an exhausted Brunsviga calculating machine.

Vogelstruis Deep.—The circular issued by the directors of the Vogelstruis Consolidated Deep has created a feeling of wide dissatisfaction, although the unfavourable nature of its purport must have been anticipated for some weeks by those informed concerning the early career of the mine. Owing largely to "premature birth," the mine has been losing money every month. On the small scale of crushing operations attained—under 10,000 tons per month—costs have been extremely high, and the yield has been consistently lower than ore-reserve estimates indicated. The circular, calling for fresh funds from a timid market, is tantamount to a burial notice, even though there may be a resurrection in time to come. It is estimated that the reserve now stands at 170,000 tons of South Reef at 5¾ dwt. over 37 in., and

15,000 tons of Main Reef at 5 dwt. over 78 in. The milling of these reserves should yield profits "provided the plant were supplied to full capacity, which, owing to the limited amount of stope faces available is, however, not possible." In order to carry out an extensive scheme of development — in the meantime, closing down the mill—it is hoped to raise £210,000 in 6% first mortgage debentures. As this issue is not guaranteed by the controlling firm, it is most unlikely that shareholders will avail themselves of the invitation. If no money is forthcoming, the property will be closed down entirely and await more favourable times for the raising of fresh capital. The development

Elsburg conglomerate, three miles south of the Main Reef.

of the Bantjes Consolidated, which adjoins, will bear upon the destiny of the Vogel Deep and any success achieved by the Eckstein mine will hasten the return of optimism in the shareholders and directors of the hapless deep level to the south-west.

Rooderand.—In the December issue of this Magazine, I attempted to point out the palpable unreliability of the official statements issued by the Rooderand Gold Mining Co. as to the prospects of a "new reef," inspected by Dr. Jorissen and J. I. Hoffman. It was said to have been traced for 2000 ft., of which 1000 ft. averaged a 'yield' of 5 dwt. over 3 ft. 5 in. and 1000 ft. averaged 4·5 dwt. over 4 ft. It was also announced that this lode had been "tentatively called the Middle Reef." At the time of writing, perplexity was expressed as to the need for any tentative measures. The problem is now clear enough. A London circular declares that four shafts were sunk upon the 'Middle Reef' and a scheme of development undertaken. (It would be interesting to learn how much was scheme and how much development). "Recent advices shew that this reef is unpayable and work upon it has been discontinued." The foresight of the consulting engineers is now manifest and throws me, with my petty criticisms, into shame. The deposit having been named provisionally, disappointed shareholders can now enjoy the small satisfaction of calling the 'reef' by any polite and forcible name they please without upsetting the terminology of Transvaal stratigraphy.

SAN FRANCISCO.

Smelter fume troubles continue. The Bully Hill smelter at Winthrop, in Shasta county, California, is now shut-down as a result of injunction proceedings at the instance of the Forest Service. The closing of this plant came as a surprise, since there had been little complaint of damage from fume. Owing to a peculiar situation farming has been pursued without trouble in the immediate vicinity. The alleged damage is in the National Forests at some distance and many good judges have thought that in event of a contest the company could win its case. However, no fight was made. The plant was closed and the ore is to be shipped, temporarily at least, to other furnaces. The company is investigating plans for abating the nuisance and a modification of the degree under which the plant was closed has been entered so that if a satisfactory scheme can be evolved work may be resumed. The question is often asked why it is that smelters out in the Western States, where the land is generally worthless for agricultural uses, have so many contests with the farmers while those in the Eastern and Middle States, where practically all the land is under cultivation, go free. It is not easy to give a complete answer; for one thing, land suitable for fruit-raising or market gardening especially, situated near a Western smelter, has a monopoly value; at the same time the prevailingly arid conditions undoubtedly enter into the struggle for vegetal existence and an amount of fume that would not seriously interfere with the growth of plants where other conditions are favourable, is locally disastrous. Still another factor is the fact that in the densely settled States, where industries are well established, sulphuric acid can be profitably made and sold while in the West any large quantity would be as troublesome as is the fume. It is possibly significant that the new Pine Canyon plant of the International

Smelting Co. is situated in the midst of a great barren tract over all of which the company either owns the fee or smoke easements.

Smelter Smoke.—The copper smelters of Shasta county, California, have met the smoke problem in various ways. The Mountain Copper Co. has erected an acid plant and manufactures fertilizer. This is much the most satisfactory method, where feasible, but the local market for fertilizer is limited and a foreign market can be but slowly developed. The Mammoth Copper Co. has added a bag-house and neutralizes the sulphurous oxide by introducing a zinc oxide fume. This process, developed at the Midvale (Utah) plant of the U. S. Smelting Co., the parent corporation, seems to be effective, but the installation is expensive. The Balaklala company has been preparing to install the Cottrell process. This, a method of precipitating the solid particles in the smoke by electric discharges, was developed by F. G. Cottrell of the University of California, in the course of some experiments relating to the contact process of making sulphuric acid. The possibilities of the process in connection with smoke abatement were promptly recognized and at the works of the Selby Smelting & Lead Co., near San Francisco, the device was perfected. The first plant erected at the smelter treated 5000 cu. ft. per min. of fume heavily charged with acid coming from the refinery. The process has now been applied to the roasters and 50,000 cu. ft. per min. of smoke from them is being treated with marked success. At the Balaklala smelter 500,000 cu. ft. is the volume to be handled. In this case the stack was tapped and a small temporary chimney carrying 1% of the total volume was built. An experimental plant was erected and from it, as a result of several months' work, designs were drawn for the large working plant now being constructed. In the practical application of the process the first difficulty was that of securing a suitable current, the old static machines being notably defective. This was done by 'stepping up' a direct current to high voltage and arranging for contact at the crest of each wave, for example, in a three-phase current. The second difficulty was that of a suitable surface for discharging the current—one that would give an even flow. At the Selby plant this has been found in roughened mica plates; at Coram, strips of asbestos are to be used. In general the difficulties are being overcome as they arise and the rapid development of the device from laboratory apparatus capable of handling one cubic foot per minute up to the new installation treating a half million, speaks well for the care and accuracy with which the experimental work has been done.

The Cottrell process is finding other applications than to treatment of smelter smoke. The electric discharges, it seems, are capable of precipitating any finely divided solid or liquid matter. Gas alone is beyond their power. One of the most recent uses to which the process has been put is that of settling water out of oil. Crude petroleum is nearly always mixed with water and where gas is also found, the water and oil may be churned until an emulsion is formed and the oil not be cleared of water by mechanical means. In one case such material has been kept standing for three years with no material improvement. The pipe-lines will only take oil containing a maximum of 2% of water and as much as 24% is sometimes present. Mr. Cottrell has built a simple station in the oilfields for treatment of such emulsions and has successfully handled, at a satisfactory rate, products containing 17% of water. Additional plants are now being erected and what was practically a waste product is being readily marketed.

The Goldfield Consolidated continues to make an enormous production at huge profit. Mr. Finlay's figures for June show the milling of 20,091 dry tons of an average value of $45·27, giving a total gross value of $909,480. Of this $868,264 was realized, or a recovery of 95·47%. The general costs, including bullion tax, marketing bullion, and administration amounted to $1·84 per ton; mining to $3·98; transportation, $0·14; milling, including cyanidation and marketing concentrate, $2·74; construction and fire loss, $3·23; a total net cost of $11·93, to which should be added $2·05 for loss in tailing. The profit was accordingly $31·29 per ton, and the total profit $628,464. Development went forward at the rate of one foot for every seven tons mined, and the average ore taken from the main levels assayed $86. All the essential parts of the mill are complete and running at full capacity. Other construction work is going forward rapidly and it will all be completed in October; in the meantime it is being written-off more rapidly than the money is being spent. In connection with the listing of the stock on the New York Exchange the old certificates are being called in and new ones issued for each $100. The un-issued stock has been cancelled and the capital has been thereby reduced to $35,951,480.

Nome.—A late spring is reported in this part of Alaska. When the first steamer ar-

rived on June 2, the hills about the town were still covered with snow, and water for the spring sluicing started two weeks later than usual. The spring clean-up in the vicinity of Nome is estimated at $1,000,000 and for Seward Peninsula as a whole, $1,325,000. This is the smallest for several years. The winter brought no new discoveries of great importance but substantial and gratifying progress was made in reduction of costs. Last fall the labour-union voluntarily agreed to a $3 wage-scale and operators were thereby encouraged to undertake treatment of gravel containing only three cents per pan in the place of the five or six cents, previously marking the lower limit. At this rate a 2 or 3-ft. 'pay-streak' in frozen ground sampling $4·50 per cubic yard became profitable. The Pioneer Mining Co. worked a 7-ft. pay-streak averaging only $1·87 per yard at a profit of 62c. The Miocene Ditch Co. has been absorbed by the Pioneer Mining Co. and Col. Lionel Stuart-Weatherby, British vice-consul at Nome, acting for English investors, has secured control of the North-western Development Co., the John J. Sesnon Co., and the Nome Mining Co. This brings important railway, lighterage, electric lighting, power, and merchandizing interests into strong hands. Incidentally the Bourbon Creek dredge and other mining properties go into the combination. Dredging promises to be active at Nome this year, at least ten new boats having been shipped, with probably three more to follow. In the main the work is being undertaken by experienced and responsible companies but the opportunities for fleecing the

PROSPECTORS AT NOME, ALASKA.

public are too good to be entirely overlooked by fake promoters. Stock in schemes that have hardly any chance of success is being widely peddled. Persons solicited to buy would do well to remember that in the Far North placer ground must be tested not only for gold but for ice. The absence of the one is no more fatal to success than the presence of the other.

NEW YORK.

Panama and the Canal Zone are to be visited this fall by the American Institute of Mining Engineers, the party sailing from New York on October 29 and returning on November 25. Arrangements have been made to visit Cuba, Jamaica, and possibly other West Indian islands. Since the beginning of work on the Isthmus the wish has been frequently expressed for such an excursion and a large number will doubtless attend. It is a striking evidence of the speed with which the Canal is being built that the visit must be made this year in order to insure seeing much of the more interesting work of excavating. The steam-shovel operations in the Culebra cut will be of especial interest to engineers dealing with the great modern iron and copper mines, while on the Pacific division hydraulic digging with methods developed in Californian gold mines may be seen. There are engineers who still maintain that at the Culebra cut it would have been better to adopt mining methods, running a tunnel at grade and removing the dirt through winzes. This would have given permanent track on which to handle the traffic and would have simplified drainage problems. The matter is now of academic interest only but doubtless will be discussed repeatedly during the visit. The American Institute is a great peripatetic institution and as in the days of Aristotle both teacher and scholar learn much while travelling about.

Mine-rescue work has never received the attention in America that has been devoted to it abroad. Fortunately conditions have begun to improve, particularly as relates to coal mining. The new Bureau of Mines maintains a central station at Pittsburg, in Pennsylvania, with branches at Urbana, in Illinois, Knoxville, in Tennessee, and Seattle, in Washington. At all of these men and apparatus are available for service in case of accidents, and at each instruction is given to men coming from the neighbouring collieries. Congress has just appropriated money for nine more such stations and the State of Illinois for three. In addition a number of private corporations maintain similar equipments. The metal mines have been less well served; probably because accidents in them are not so striking as are the great disasters due to explosions in coal mines. It is far from certain, however, that the death rate in metal mines is not as high. The duties of the Bureau of Mines were extended this year to cover the study of accidents in all mines. In the meantime the general manager for the Goldfield Consolidated Mines Co. has taken serious hold of the problem and has organized a division of inspection charged with the especial duty of providing for the safety of employees and property. Not only are first aid, rescue, and fire corps being organized and drilled, but provision is made for thorough and regular inspection of all machinery and working places. Finally, sanitary and living conditions are to be studied and investigations of diseases incident to mining are to be made. While hospitals are provided and inspections are systematically made at many American mines, Mr. Finlay's plans go much farther than is common. If it seem to others that the task is but tardily assumed, the great dependence on individual initiative which has characterized the development of the mining industry of Western America should be remembered.

Nevada Consolidated.—The active properties in the Ely district are those of the Nevada Consolidated Copper Co., Giroux Consolidated Mines Co., Ely Central Copper Co., Boston-Ely Mining Co., and Ely-Centennial Copper Co. The Nevada Consolidated is mining and milling 240,000 tons of ore per month, containing 2·1% copper, and about 40 cents per ton in gold. All of this is mined by the use of five Bucyrus steam-shovels, which are operated in one main pit or excavation, at Copper Flat, seven miles from Ely. This pit is approximately 2000 ft. long, 900 ft. wide from rim to rim, and 180 ft. deep. The general progress of excavating is westerly, which is the strike of the ore zone. The steam-shovels operate on four terraces. The overburden, 40 to 60 ft. thick, is hauled to the waste dump, except a defined portion of it, which runs well in copper and gold, and is shipped to the smelting plant to line the converters. A quarter of a mile west from the first pit, a new pit is being opened, in which two steam-shovels are to be operated, so as to increase the tonnage of mill ore. The concentrating plant, which was built in eight sections, is exceeding its nominal capacity. It is claimed that 9000 tons per day is being treated, although one section is idle, and that as high as 10,500 tons have been concentrated in 24 hours with the eight sections running. The changes made within the last

year consist in operating the coarse rolls dry, instead of wet as formerly, and eliminating the trommels between the feed and the coarse rolls; also eight Steptoe classifiers have been added to each section, in order to classify for the tables and vanners the re-ground products of the Huntington and Chilean mills. These classifiers consist of a somewhat radical modification of the Yeatman classifier, as described in Richards' 'Ore Dressing.' The modifications were made by Geo. F. Waddell, mill superintendent, and his assistants. The concentration is in the ratio of 10 : 1. C. B. Lakenan, general manager for the Nevada Consolidated, states that the result of the mill-work is a saving of 71·8% of the copper content of the ore. The concentrate is roasted in 16 McDougal furnaces, then smelted in five reverberatory furnaces, each 110 by 19 ft. One additional reverberatory is being built. There are four stands of converters, three shells for each one. A Nordberg blowing-engine, with a capacity of 18,000 cu. ft. free air per min., has been erected, since January, to supply the blast for the converters.

The Giroux Consolidated Mines Co., for which Frank P. Mills is manager, recently completed a 5-compartment shaft to a depth of 1200 ft. This shaft was sunk off the ore zone, in solid limestone, 750 ft. southwest of the old Alpha shaft of the same depth. While the Alpha was unsatisfactory on account of caving ground and an excess of water, the new shaft is in firm ground and has tapped no water-channels. Pumps are being installed at 1200-ft. station of the new shaft, and as soon as they are ready to operate, a cross-cut is to be driven to the vicinity of the Alpha to drain that territory, the latter shaft now holding 200 ft. of water. The plan is to have pumping facilities ready to handle the volume of water thus to be tapped. Aggressive mining operations will be commenced after the Alpha has been unwatered, as the natural flow ought not then to be excessive. In the meantime, a new power-plant, to have eight steam-boilers, two hoisting engines, and an air-compressor, is being placed 400 ft. from the new shaft. The shaft has two compartments for skips and one for a cage. A 94-ft. steel head-frame is being erected.

The Ely Central, in charge of Lee Glockner, is developing from its Eureka shaft, sunk on the porphyry zone, and from its Clipper shaft, which was sunk at a spot 4000 ft. west, on a fissure in the limestone. The Boston-Ely, whose holdings lie northwest of those of the Veteran group of the Nevada Consolidated, has an 1165-ft. shaft, from which lateral work is in progress. This property is in charge of E. W. Ralph. The Ely-Centennial Copper Co., controlled by Salt Lake and Ely men, is developing promising territory in the limestone, half a mile north of the town of Ely.

Death Valley has recently come into renewed prominence through the tragic death of Charles S. Davidson, a young engineer from Berkeley, California, who was leading a surveying expedition in the desert. Mr. Davidson, who had heart trouble, had been warned against the trip by physicians, but thought it necessary to go. Other members of the expedition, including Norman C. Stines who has since gone to Siberia, came through alive though subjected to much hardship. Back of the sorry story of Mr. Davidson's death is a sordid tale of which the whole truth is not yet apparent. The expedition was secretly dis-

A mining town on the desert in Nevada.

patched to survey, and it is alleged to 'jump,' claims held by the California Trona Co. The lands include certain salt lakes containing large quantities of bicarbonate of soda, nitrate of soda, and other salts. The California Trona Co. was formed to develop these deposits but after borrowing from the Foreign Mines Development Co. found itself unable to carry the matter through and application had already been made for the receiver in the interest of the British mortgagees. In the meantime the Trona company had at one time given an option to powerful Eastern interests and it is said that the failure of the Easterners to exercise their option caused the failure of the Trona company. It is now alleged that the attempt to jump the claims was made in the interest of men who had held an option on the property, and who, therefore, were attempting to get it without taking into account either the Trona or Foreign Mines Development company. As Mr. Davidson seems to have been the only member of the expedition who knew its purpose, the truth

of these charges can not be proved though they are apparently well sustained. His death and the attendant publicity defeated the purpose.

MELBOURNE.

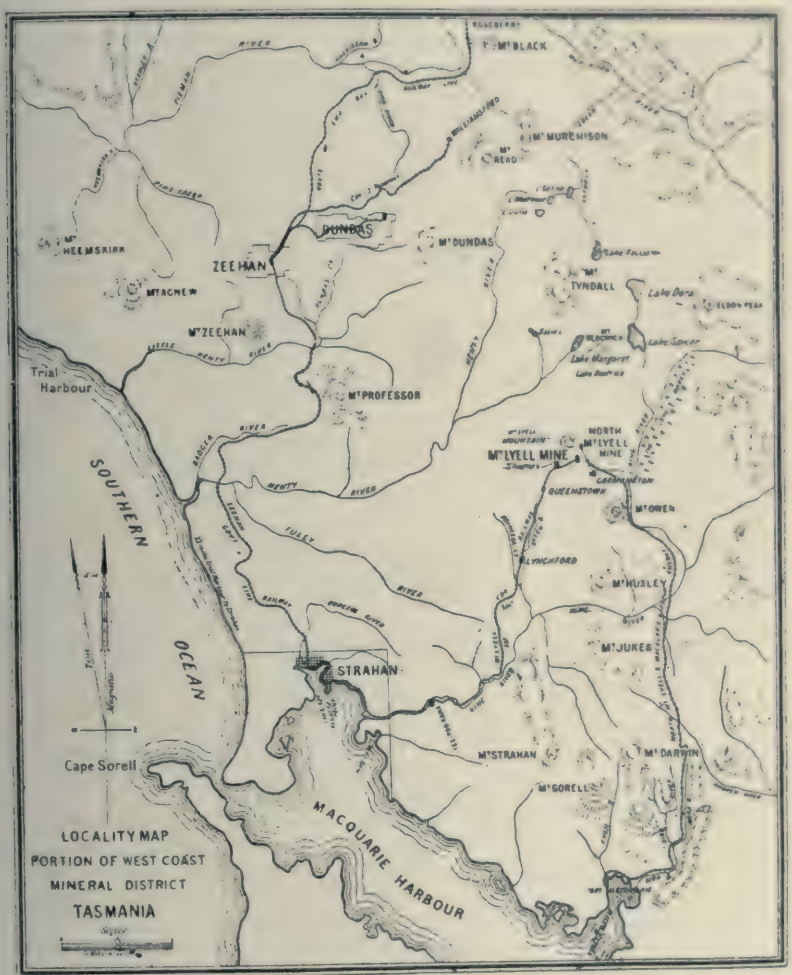
Broken Hill.—The most important recent event in Australian mining has been the adverse development at the Junction North mine, Broken Hill. To understand the position it has to be realized that the outcrop of the great Broken Hill lode, after leaving the British Broken Hill lease bends sharply into the Junction and the Junction North mines, whence it makes northeast into the North Broken Hill lease. The shoot of ore worked by the Junction North curves into the mine at the southerly corner and then extends across the boundary into the Broken Hill North claim. The length of the shoot at the No. 11 level of the Junction North mine was approximately 600 ft., and extended 500 ft. into the North mine. Then follows a gap of barren country, beyond which is the northern shoot of ore of the North mine some 600 ft. in length. The Junction North Co. had sunk a winze from the 1100 ft. level at 300 ft. from the heel of the shoot of ore, or midway to their north boundary; this ore went down 83 ft. and then died out. Before that they had sunk their shaft to 1300 ft. and were driving west to pick up the lode on its dip. This they failed to do and they could not find it by means of the diamond-drill. Then they went along the No. 11 level to a point 100 ft. distant from the North Broken Hill boundary and put down radiating bores which so far as they went seemed to indicate that there was no great depth of ore at that point. Then they came back to the No. 11 level winze and bored first west, but unsuccessfully. Then they bored east, opposite to the dip, and found low-grade sulphides and folded country.

The contention of the North Broken Hill officials is that everything that has happened is in accord with the behaviour of the upper portions of the orebody, and that as the pitch to the north had been 100 ft. for each 100 ft. of depth it was to be assumed that the ore would make north as it has done. There is a good deal of truth in this contention. Still it could not have been foreseen that practically 600 ft. in length of the orebody would be lost in less than 100 ft. of depth, for at the point where the boring was done the lode at No. 11 level was over 100 ft. wide and well defined. While the officials of the North company are confident, it must be admitted that other local mining men are much concerned over the results. In some quarters the intention is to abandon lifts of over 100 ft. in depth. The truth about the North company cannot be known until either the next level is opened up or till the present level is extended farther north and more boring done below it. Till then the proper thing is to suspend judgment, but it is to be hoped that the British shareholders will insist that the company pushes ahead its work in this direction. Of course, the North company, having two ore-shoots, is well off; but if the ore to come in from the Junction North is to be shortened by nearly half its length it will be a great disappointment to all concerned.

Geology.—In connection with the Broken Hill ore deposits the writer had the pleasure of an interview with T. E. David, professor in Sydney University. He has been visiting the district and his statement is as follows: "Our knowledge of the Broken Hill deposits indicates that, in a very ancient formation, probably of pre-Cambrian age, composed of sedimentary rocks, strong folds were developed. The earth's crust in that region was bent like a sheet of corrugated iron. But the folds instead of being symmetrical were pushed over isometrically from the northwest to the southeast so that the southeastern folds became first vertical and then overhanging toward the southeast. During the process of the folding the rocks crust yielded under the great pressure, fracturing in places, the fractures taking the shape of sheared planes dipping from southeast to northwest, or parallel to the overhanging sides of the folds. In addition to the nearly vertical fissures, the strata were dragged apart at the tops of the arches of the folds, so that cavities like those of a saddle-reef were developed. Into these cavities the mineral solutions were probably introduced from below. These solutions attacked the walls of the original fissures and enlarged the cavities. The first solutions to enter contained silica with garnet and rhodonite. Later there entered the various sulphides, galena and zinc blende, with some copper and iron pyrites, together with traces of mercury and occasionally a little arsenical pyrite. The filling of the spaces was also closely connected with a widespread development of aplitic or pegmatite dikes. These dikes passed by imperceptible gradations into what might be called intrusive quartz reefs. Such pegmatites occur next to the orebody and indeed much of the ore itself is largely formed of nearly pure felspar and quartz accompanied usually by garnet and rhodonite. At a still later date a continua-

tion of the powerful earth-pressure expressed itself in a transverse fault found in the Central and the South mines. This was in the nature of an overthrust, the country rock and orebody on the northwest side of the lode being forced up the inclined plane in a southeasterly direction."

Tasmania.—At Rosebery, near Mount Black, three companies are working on the same lode: the Tasmanian Copper Co., the Primrose, and the North Tasmanian Copper Co. The Tasmanian and the Primrose companies are jointly driving a low level adit, which is now in good ore. For some years these two companies sent their ore to Zeehan, where it was smelted by the Tasmanian Smelting Co. At the present time, owing to various causes, no ore is being sent to Zeehan. The Tasmanian Copper Co. is under contract to supply the Metals Extraction Co. with ore, and that company is supposed to be erecting a treatment plant, but so far the work has been done in a half-hearted manner. The Primrose mine was recently sampled by J. H. Fawcett on behalf of Melbourne capitalists, and a shipment of ore was despatched for trial by the Horwood process at the Bendigo School of Mines.



At Mount Read two important companies are operating: the Mt. Read Co. (an English company) and the Hercules. The former is doing nothing; the latter used to send its ore to the Tasmanian Smelting Co., at Zeehan, but has since stopped, and is negotiating for the erection of a small unit of plant for Horwood's process, on which successful experiments are reported. Between Mt. Read and Mt. Black the Tasmanian Smelting Co. own many leases, on one of which, the Jupiter, a small orebody was struck, but so far it has proved of no real value. All the above mines yield a dense sulphide ore containing zinc and lead, with silver and gold, and about 1% copper, and have been subject to a returning charge, the zinc not being paid for. The Tasmanian Smelting Co. has recently taken the Florence silver-lead mine on tribute, and has been pumping the workings for the last eight months. The Florence is situated in the middle of the town of Zeehan; the deepest workings are 200 ft. The Comstock mine is between Zeehan and Mt. Agnew, and although taken over by Block 10 has done scarcely anything up to the present. It is doubtful whether any ore has been sent away.

Maroonga.—Great interest is being displayed in the new Mount Maroonga silver-lead deposits, in Arnheim's Land, in the Northern Territory. The first batch of parties sent from Port Darwin have returned to the telegraph line. These have done a lot of

pegging and so it is perhaps not desirable to attach too much importance to their reports. Still they all agree that there are large outcrops and that these carry carbonates of lead and galena. One of the latest visitors is somewhat more cautious than his predecessors and states that the outcrops consist of "diorite dikes." However, the real facts should be soon known, as Andrew Wilson, a well-known mining man and properly equipped, has reached the locality. He will not hesitate to speak adversely, if necessary.

MEXICO.

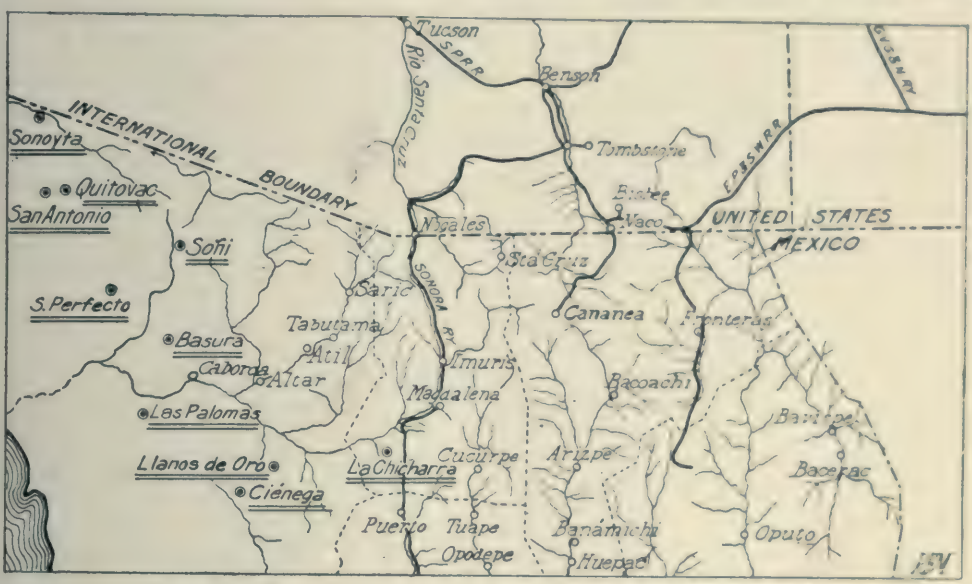
Greene Consolidated.—The annual report of this company contains many interesting details concerning Mexico's most important copper enterprise. The Greene Consolidated is the American company owning the entire capital stock of the Cananea Consolidated Copper Co., the Mexican organization with title to the principal mines and reduction works at Cananea. The merger of interests proposed by the Cole-Ryan Syndicate in connection with the Greene Cananea Copper Co., a $60,000,000 concern, has not been perfected as yet, because there is still outstanding some of the stock of the Greene Consolidated, the Cananea Central, and the Cananea Duluth, the three American companies that are to be combined. In 1909 the total revenue of the Cananea Consolidated was $5,510,845, and the expenditure $4,408,286, leaving $1,102,559. A total of $558,451 was charged to depreciation and improvements, leaving a net profit of $544,107. The ore treated during the year reached a total of 1,061,536 tons, yielding 44,547,689 lb. copper, 933,549 oz. silver and 5877 oz. gold. The cost of producing the copper, with the value of the precious metals credited was 11·64 cents per pound. The total cost of mining and extraction was $5·46 per ton of ore as against $5·97 in 1908, $7·62 in 1906-'07, and $10·21 in 1905-'06. Smelting costs were reduced to $3·09, as against $3·86 in 1908 and $6·82 in 1907. The Cananea Consolidated has been using oil as fuel since the resumption of operations in July, 1908, a concession for free importation having been secured from the Mexican government; hence power costs have dropped from $16 to less than $7 per horsepower-month. The company is now building a second reverberatory furnace, in connection with which a battery of five boilers will be installed, and has ordered six additional McDougal roasting furnaces. Two 1200-kw. Curtiss turbines will also be added this year, giving the company a total capacity of 5000 h.p., and it is expected to supply power to other companies at Cananea. L. D. Ricketts, general manager of the Cananea Consolidated, states that the completion of proposed improvements will give a capacity of 6,000,000 lb. copper monthly.

Altar Placers.—Attention is being directed to the dry placer deposits of the Altar district in Sonora. Recent denouncements, to the number of 700, cover thousands of acres, and titles are being awaited. Under the new mining law no work can be done until title is secured. The American Ore Milling Co., which controls the patents of the Quenner crushing and pulverizing machine, the invention responsible for renewed interest in the Altar placers, is operating a plant at Boludo, pulverizing 150 tons of the cemented gravel daily and extracting over 40 oz. gold by dry washing. D. Stonestreet, formerly of South Africa, has just installed a plant with a capacity of 20 tons per hour near Llano. Several other Quenner machines are in the district. The Neill Development Co., a Spokane company, which recently acquired the extensive Palomas placers in the Altar district, has ordered 15 Quenner machines and will treat 3000 tons of the cemented gravel per day. An automobile road is now being built from Nogales on the international boundary, to Altar, and regular automobile service will be established. The Quenner machine is simple in construction, being in reality a trommel within which steel hammers, swung on chains from a central shaft, revolve.

Sonora Copper Smelting Co.—This Kansas City company, with a nominal capital of $3,000,000, promises to establish another big copper enterprise in Sonora. It has been developing properties in the Magdalena district, three miles from Noria, a station on the Sonora Railway, for more than three years, and the workings now aggregate two miles, with approximately 350,000 tons of proved ore. Equipment for a 100-ton smelter is on the ground, and the plant should be in operation early next year. The smelting capacity will be later increased to 500 tons daily and a concentrator added. A liberal concession, exempting the company from all State and municipal taxes for a period of 20 years and providing against the granting of similar exemptions to any other concern in the Magdalena district during that period, was secured from the State government. The company expects to do custom work. A. M. Coward is president and general manager.

Moctezuma Copper Co.—The annual report of this Phelps-Dodge company, operat-

ing the Pilares copper mine and a 2000-ton concentrator in the Nacozari district of Sonora, shows dividends of $988,000 last year. A balance of $2,407,984 was carried over from 1908, and after the payment of these dividends and charging $363,009 for plant depreciation, the company had a surplus at the end of 1909 of $2,161,430. The net earnings last year were $1,104,454. Scarcity of water forced the company to suspend operations at one of the two units of the concentrator, but the summer rains now due will enable the plant to be worked at its usual capacity. Production has been maintained by the shipment of high-grade ore, of which there is a good reserve. All products go to the Copper Queen smelter at Douglas, Arizona.



STATE OF SONORA, SHOWING POSITION OF ALTAR AND CANANEA.

Teziutlan Lawsuit.—A flurry was caused recently by a judgment for 23,059,084 pesos, given by the Second Civil Court of the Federal District in favour of the Compania Explotadora Mexicana against George D. Barron, and supposedly involving the Teziutlan copper mines in the State of Puebla, operated for several years by the Teziutlan Copper Co., one of Robert S. Towne's enterprises. The case has been in the courts since 1900. The Compania Explotadora was organized in 1895 by men well-known in Mexico, the object being to acquire and develop mines in the Teziutlan district of Puebla, and Mr. Barron was elected president and general manager. The case against Barron was based on the allegation that the company authorized him to acquire the Aurora and other properties which have since become big copper producers, and that instead he took titles in his own name and later transferred the properties to the Towne interests. The further allegation was made that the company's money was spent on the properties. The judgment of the Second Civil Court was based on the production of the Teziutlan Copper Co., with an addition of interest at 6%. Mr. Barron has resided in the United States for some time, and the judgment was by default. Representatives of Mr. Barron declare that it cannot be shown by books or documents that the Compania Explotadora even authorized him to acquire the Aurora and other properties involved in the case; that he never owned the properties, and that they have been of minor importance in the success of the Teziutlan Copper Co. The Towne interests give no evidence of being worried by the action of the Court. The Teziutlan Copper Co. has a 1000-ton smelter and is one of the most important copper producers of Mexico.

Lewisohn Interests.—A few months ago the Lewisohns of New York took a short option to purchase control of the Pacific Smelting & Mining Co., an $8,000,000 company owning mines and the Fundicion smelter in the State of Sonora. This deal was not made, but as a result of the examination of the Lewisohn engineers copper properties opened by the Pacific Smelting & Mining in the Yaqui river region were taken under bond and are now being developed. These properties were with-

in the boundaries of the Ryall exploration concession, and just before the expiration of this concession the Pacific Smelting & Mining Co. denounced for the Lewisohns much adjoining mineral land. The holdings total over 1200 pertenencias and the bond price is $100,000. The Ryall concession covered many square miles and became a holding of the Pacific Smelting & Mining at the time of its organization. The Government declared the concession forfeited last April. The Lewisohns are also interested in the Guanajuato district, having the old San Cayetano silver mines and several adjoining properties.

Important Merger.—Much interest attaches to the proposed merger of the Mines Company of America, operating the Creston Colorado mines in Sonora; the Dolores Mines Co., owning the Dolores gold mine in western Chihuahua, and the El Rayo Mines Co., operating in the Parral district of Chihuahua. It is planned to increase the capital of the Mines Company of America from $2,100,000 to $9,000,000, and exchange the new stock for Dolores and El Rayo stock on a basis of ten to one for the former and seven to one for the latter. The Dolores has a capital of $2,000,000 in 400,000 shares of $5 each, and all the stock is outstanding. The capital of El Rayo is $1,000,000 in 500,000 shares at $2, and 352,000 shares have been issued. In 1909 the Mines Company of America paid dividends of $340,000, and the Dolores dividends of $462,896. For the year ending October, 1909, El Rayo paid in dividends $137,089. Men interested in the U. S. Steel Corporation and the U. S. Realty Co. are principally interested in the Mines Company and the Dolores, and El Rayo is controlled by Wm. B. Thompson and H. Hinckle Smith, of Philadelphia. The Mines Company of America recently closed a deal for the properties of the La Dura Mining & Milling Co., in the Yaqui region of Sonora, and these properties are also included in the merger.

CAMBORNE.

Hingston.—The inability of the directors to find further capital for the purpose of once more reopening the Hingston mine near Tavistock is greatly to be regretted. When this mine, together with Gunnislake Clitters and other old properties, was acquired by an Anglo-German group ten years ago and modern plant including magnetic separators erected, it was thought that a new era had arrived in Cornwall. The subsequent history is sufficiently well known and need not be repeated now. Mr. Allen, who found capital a year ago to restore the mine after the collapse of the company and the concurrent flooding, has not been able to persuade anybody to provide the necessary £25,000 to develop the mine and remove the dressing plant from Clitters to Hingston. The Clitters mine has never been worked below adit, and the orebodies do not give sufficient inducement to follow them down, but at Hingston there are better prospects and seeing that there is a dressing-plant on the spot it is a wonder that somebody does not have the courage to come forward.

St. Agnes Consolidated.—The statutory report of this company shows that 274,933 fully paid shares of 10s. each have been issued in exchange for licenses or agreements to work the following properties: Blue Hills, East Blue Hills, Wheal Prudence, Royal Polberro, West Polberro, West Polbreen, St. Agnes Well, Wheal Freedom, all of which are waterlogged mines. In addition, the contract for the purchase of West Kitty mine has been transferred to the St. Agnes Consolidated by the National Minerals Corporation. The only cash provided so far appears to be £11,260 raised chiefly on participating bonds, and as most of this sum has to be spent at West Kitty, nothing is apparently yet available for the other setts. At West Kitty, a little development work is being done in the Wheal Friendly sett, from which the water has again been drained; a cage-road has been substituted at Thomas's shaft for the skip-road formerly there, but the pumps have not yet been restarted. Less than 100 hands are now employed.

Consolidated Tamar Mines.—This private company with a nominal capital of £60,000 has recently been formed to work the Danescombe, Kelly, and Calstock Consols setts, which are situated in the Danescombe valley, near Calstock. These are old mines formerly worked chiefly for copper, but according to G. C. Moor who has recently examined the property, wolfram is also present in large quantities as well as tin and arsenical pyrite. Much ore was left above the adit by the 'old men' when by-products were not appreciated as they are today. About 150 men are employed and the mines are being equipped for a large output. The Rumleigh arsenic works which are a mile north of Calstock have also been acquired.

China Clay.—It is reported on good authority that two of the most important firms in this industry namely John Lovering & Co. and the West of England China Stone & Clay Co. are to be consolidated. If the scheme matures, the combination will undoubtedly be the largest producer of china clay in the world.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

July 1910.	June 1910.	July 1909.
£54. 5s. 5d.	£55. 8s. 11d.	£58. 14s. 1d.

Not since December 1902 has standard copper sold at the low level reached during July when three months copper was sold at £53. 7s. 6d. The month opened with adverse conditions in every direction; especially in America, where unfavourable crop reports, and a legal decision against the railroads created something like a panic and unsettled stock markets. Copper itself showed at first some resistance to the general downward tendency. European buyers purchased on a fair scale, American trade was active, producers with the exception of Amalgamated were well sold and bears on this side were covering. But a study of the American producers' figures combined with a flood of fresh liquidation in Wall Street precipitated a rapid decline which for a short time put a stop to consumers' purchases and took the heart out of the bull speculators. Amalgamated at this point surrendered to the market after their long indifference and broke their price of 13 cents. Assisted by bear covering they were able to sell large amounts at 12½c. with leading European people and with consumers at home. The menace to the market of large accumulated stocks of unsold copper being thus removed lent encouragement once more to operators for the rise. Their hopes were further revived by renewed negotiations on the part of the representatives of the largest American producers then on this side of the water with a view of coming to a definite arrangement for restricting output. The ultimate success of these schemes is said to be entertained in the most influential quarters, but although various estimates of the reduction are rumoured, from 10 to 20%, details of the methods by which the companies will comply with the federal laws are not officially published. The course of prices was rapidly changed by these reports and in two sessions of the Metal Exchange were marked up 35s. Bears who had been active then covered freely, and on each decline large purchases accredited to American interests rallied prices to a still higher level, three months' copper at the final session of the month being £56. 5s. Consumers who have long been carrying low stocks showed an unwonted concern in prices and the month ended with a burst of activity which has long been absent from the market. Trade reports are in every branch favourable and appear to be going from good to better. This is especially the case in Germany where factories in Westphalia are working night and day and have even had to decline orders owing to being occupied to their fullest capacity.

TIN.

Average prices of cash tin:

July 1910.	June 1910.	July 1909.
£149. 2s. 1d.	£148. 13s. 1d.	£131. 19s. 1d.

Tin has shown a remarkable steadiness during the month, its stability being almost unaffected by the excitement in copper or in stocks. Consumption especially in America is good, and a large volume of genuine business has been done. The speculative interest is small. Since the forced liquidation on behalf of continental operators induced a decline of about 20s., prices have recovered and remain at about the opening values. Prices were also kept down for the Banka auction when 2240 tons were sold at an average of £150. 5s. The tendency at the close of the month is firm and hopeful, and statistics are favourable.

LEAD.

Average prices of soft pig lead:

July 1910.	June 1910.	July 1909.
£12. 11s. 8d.	£12. 13s. 9d.	£12. 13s. 3d.

Lead was dull and steady until quite the end of the month when a burst of buying by provincial consumers gave animation to the market. Most works still remain poorly supplied with metal, scorning to buy ahead on what appears to them a falling market. Market conditions are quite healthy and on the continent where the cable industry is particularly active there is considerable inquiry.

SPELTER.

Average prices of spelter:

July 1910.	June 1910.	July 1909.
£22. 5s. 5d.	£22. 3s. 2d.	£21. 18s. 9d.

A distinct improvement is noticeable in spelter and prices have advanced about 10s. per ton. Consumers who have been working with low supplies for months past have bought well and the improvement is felt in all branches, applying equally to galvanizers, sheet rollers and the brass trade. Prices of galvanized iron and sheet zinc have been advanced. Good orders have been given.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

The Oilfields of Mexico.

The Editor:

Sir—I read with considerable interest in your July number the article on 'The Oilfields of Mexico' by H.S. Denny, and also the paragraph on Petroleum, appearing in your San Francisco correspondence. These articles are in my opinion both good and interesting, but there were one or two details upon which your correspondents were in error.

In regard to Mr. Denny's references to the Mexican Petroleum Co.; there are two Mexican Petroleum companies, one being the Mexican Petroleum Co. of California, and the other the Mexican Petroleum Co. of Delaware. E. L. Doheney is the head of both of these companies. The Mexican Petroleum Co. of California started operations at Ebano and had been operating for some time when the Mexican Petroleum Co. of Delaware and the Huasteca Co. were formed, and now about 93% of the stock of the Mexican Petroleum Co. of California and all of the stock of the Huasteca Co. is owned by the Mexican Petroleum Co. of Delaware. Therefore all the Doheney interests are under the control of the Mexican Petroleum Co. of Delaware.

These companies are making calculations for a very large increase in production, which at present is about 8500 bbl. per day, and they expect to increase to 20,000 bbl. per day within the next two years. I recently spent a month examining these properties, and reported upon them for these companies.

Your San Francisco correspondent states that the pipe-line charge to the coast is 22½ cents per bbl. While the pipe-line company, in agreement with the producers, is allowed to charge a maximum of 22½c. per bbl., the charge has only been 12 cents per barrel.

The Independent Producers Agency was a combination of the oil-producers of Coalinga and Kern county, California, and was formed for the purpose of regulating prices. The price of oil in these interior districts was subject to wide fluctuations. When over-production ensued, the price dropped suddenly; there was then a suspension of development work, and as the consumption was always increasing there followed a shortage of supply. Prices would then soar, and consequently development work would be stimulated, followed by another period of over-production. The marketing companies usually took advantage of these conditions, which caused general dissatisfaction among the producers; hence the organization of the Independent Producers Agency. The Union Oil Co., which is the largest marketing corporation in California, joined the Independent Producers and now acts as a selling agent; and up to the present has been successful in maintaining the production on a basis near actual requirements.

Those not acquainted with the situation would naturally inquire why the market companies do not build more storage-tanks. The reason is that iron storage-tanks, which are the only satisfactory means of storing oil, cost 25 cents per bbl. to build, and as oil can be obtained for 50c. per bbl. in the districts above mentioned, it is not a profitable investment, owing to the uncertainty of new fields being opened up, and cheaper oil becoming obtainable.

The Standard Oil Co. some few years ago built large earthen reservoirs and bought oil in California as low as 15 cents per bbl., but owing to the loss by evaporation and soakage, and interest on the money, this was an unprofitable investment.

In conclusion, I wish to say that owing to the rapid increase in consumption and the better marketing facilities, the oil business in California never appeared to have a better future than at present. The general public, outside California, appears to think that the Standard Oil Co. controls all the oilfields of the United States. As a matter of fact in California the Union Oil Co. markets more oil than all the other companies combined, and produces many times more than the Standard. This, of course, does not include the consumption of the railways, which produce their own oil. While I have no figures before me, it is estimated that the railways consume one-third of the total production of California, which in 1909 amounted to a little over 57 million barrels.

EDWARD J. MCCRAY.

London, July 25.

Globe & Phœnix.

The Editor:

Sir—On page 324 of your May issue, under the heading of 'Rhodesia,' there are contained some statements on the metallurgical difficulties of the Globe & Phœnix mine due to the presence of antimony, and as consulting metallurgist to the company in question, I feel compelled to raise a few objections.

Anyone not knowing the facts and reading your comment would be led to believe that the management was deliberately throwing gold over the dump, but if official statements and reports had been read carefully by you this erroneous impression would not have been conveyed. The percentage of extraction given by you is quite inaccurate, and is, I should say, the extraction obtained by amalgamation only, no notice whatever being taken of that produced by the cyanide works.

The fact that the Globe & Phœnix occupies the fortunate and unique position of having had the value of its ore reserves doubled in the last twelve months has naturally dislocated somewhat the metallurgical treatment, as would be the case on most mines, especially when the ore contains a fair percentage of that delightful substance—antimony. You can rest quite assured that the question of profitable treatment of the ore has been gone into thoroughly at this end, where a knowledge of local conditions is of first importance. "Rome was not built in a day," and neither can alterations or additions to metallurgical plants in Rhodesia be accomplished in the same time, as it generally takes six months from the time of ordering before machinery arrives on the mine.

As regards information, I feel quite sure that the management will be only too glad to impart this when the new plant is at work, as I think the results obtained will be more acceptable and reliable when it is known that they bear the mark of success on a practical working scale.

H. T. BRETT.

Bulawayo, June 23.

Dredging for Gold.

The Editor:

Sir—In a courteous and valuable contribution to this interesting discussion, Mr. P. Goedkoop in your May issue presents an apology for European gold dredges. The letter states some facts not previously known to me, and which call for comment.

Mr. Goedkoop says that, owing to various conditions, it has been impossible to secure any but an "inferior class of men to operate dredges to go for any length of service" to isolated countries. I should be sorry to think that it is the practice of European dredge-builders to send men known to be inferior to operate them. An inferior man is worse than no man. The very fact that such a man is entrusted with the handling of the dredge assures the wrecking of the enterprise in advance. Good men can be had to go to any country where a white man can live if they are well paid, and they can be kept there if they are well fed and housed. If the mine will not stand the expenditure for an efficient staff, no attempt should be made to work it.

I am surprised to learn that Mr. Goedkoop's firm is frequently called upon to build dredges to a specification provided by clients who place their interests in the hands of a consulting engineer who has in many cases never seen the property. "If the dredge proves to be a success" in a case like this, the 'consulting engineer' deserves praise and the manufacturer also. Who supplies the information concerning the property? Who samples the ground? Who has panned the drillings or rocked the gravel from the pits? Is it a competent engineer or is it a labourer? The number of men competent to sample dredging ground is small. Their names are easily obtainable. The manufacturer takes no chance in building a dredge for a piece of ground on which a trustworthy favourable report exists. He has a right to ask for such a report, and to refuse the work unless it is presented. He is not, it is true, investing his capital in the property, but he is investing a part of his reputation.

European dredge-manufacturers will not secure orders for gold dredges from American engineers or dredging companies until they give satisfactory evidence that they can build the heavy Californian electric dredges better, quicker, and more cheaply than they can be built in the United States.

As regards fitness for the heavy dredge under all conditions, I know nothing of the Gold Coast or of Tierra del Fuego, as I have never seen these countries, but in the case of Russian and Siberian gravels, of which I have seen considerable, no Californian construction is too heavy for them.

C. W. PURINGTON.

Honolulu, June 6.

Per Square Fathom.

The Editor:

Sir—I have followed American mining practice for several years, and even wandered as far from the Brown Palace hotel as Central City, where the sturdy Cornishman still measures ore by the 'cord.' In other districts I have been accustomed to hear ore expressed in the unit of the ton of 2000 lb. There has never been, so far as I am aware, any serious objection to the use of this unit in the metal-mining operations of the Western States, whether the

ore comes from vertical veins or from inclined and flat deposits of greatly varying width.

It is true there is no deposit of ore in the United States exactly resembling the auriferous 'banket' of the Rand. But there are deposits where the mining and stoping methods pursued are comparable. In such districts as Leadville, Colorado, Joplin, Missouri, Mercur, Utah, the Cœur d'Alene, there have never been any especial difficulties in computing the cost of mining and treatment on the basis of the ton of 2000 lb. weight. Yet in any of these bedded deposits, the variations of stoping width are as great as on the Witwatersrand.

Referring to the suggestion of Mr. H. F. Marriott, on which you comment in your May issue, that the value and cost of mining the ore of the Rand shall be computed "per square fathom," I should like to ask, as a layman who has never seen the Rand, how this basis of computation is going to simplify the already somewhat complicated Rand cost-sheets?

What is a fathom? Except among sea-faring men, its use is confined to a few mining districts in England. Originally the word 'faden' was imported to Cornwall from Germany, and 'fathom' was the nearest the local population could attain toward pronouncing it. The original length was probably about seven feet. It was gradually adopted by the Land's Enders to denote the depth to which the average man can dive below the surface of the sea. Thus gradually it has come to mean in England six feet, and is in universal use as a nautical measure. There is no reason why the word should be forced into metal-mining practice in the Australian and South African gold-fields, in which the entire civilized world takes an interest. I remember to have read, two years ago, an interesting and carefully prepared paper on the deep leads of Australia. I read parts of it twice, but at the end it meant nothing to me. The value of the paper was vitiated by the writer's repeated use of 'fathom,' 'square fathom,' etc. To my mind we may as well refer to the 'port' and 'starboard' walls of a vein.

There are numerous French, German, and American shareholders in the gold mines of the Rand. Is it fair to these gentlemen, who must take an extremely live interest in the reports of the various companies, to introduce at this date an entirely new system of valuation, essentially British and limited in acceptance? To hope for the general adoption of the metric ton is impossible. Failing this, the ton of 2000 pounds comes the nearest to an universal weight possible for use in American or English mining communities.

To me it does not seem an impossible thing for a mine manager to figure out how much a ton of ore costs to mine and treat, however large the operations, and however complicated the system of accounting. The same may be said of its assay-value and the amount recoverable by the system of treatment in use. Without appearing to criticize too harshly from a distance, it nevertheless appears to me that the type of mining science which seeks to impose on the most productive gold industry of the world a system of accounting entirely at variance with standard practice as recognized elsewhere is on a par, for example, with that pseudo-science of certain modern geologists who have invented a system of rock nomenclature intelligible only to themselves.

C. W. PURINGTON.

Honolulu, June 6.

The Editor:

Sir—Although I have never been on the Rand, yet as a mining engineer and as a shareholder in some of the Rand mines I think I am entitled to record my protest against the adoption of Mr. H. F. Marriott's "square fathom" system of quarterly returns. My knowledge of the subject is entirely derived from a pamphlet, "A New Policy in Mining," containing extracts from Mr. Marriott's speech on the proposed system of returns and newspaper comments.

I find in the Century Dictionary:

"*Square fathom*, in mining, 36 square feet of the vein, measured on one of the walls, and including its whole thickness. The available amount of ore in a mine worked on a regular fissure-vein is usually reckoned by the square fathom."

This definition is a good illustration of the fallibility of dictionaries, for with an acquaintance of many of the mining districts of the world and an extensive perusal of mining reports I only know of two districts where the 'fathom'—whether it be square or cubic I do not know—is used: Lake Superior, and Cornwall. And in my mind there is no question that the above definition is wrong, for ore in fissure-veins is *not* usually reckoned in square fathoms, but in tons.

It ought to be axiomatic that any change made in mining reports should be in the direction of uniformity and not of diversity, and if Mr. Marriott had suggested the use of the square metre and gramme for making his returns, I should have felt a certain amount of

sympathy with him. I am quite sure he will hear a strong protest from the French and German shareholders when he attempts to inflict this ancient measure upon them. And in my own case I find it so troublesome to contend with the different sorts of tons and ounces in English-speaking countries and with cargas, arrobas, marcs, zolotniks per 100 poods and dolis per cubic sagene in foreign lands that I cannot welcome the introduction of this obsolete unit of measurement—the fathom—into modern mining. Consequently I sincerely hope that many other engineers will join me in protesting against this anachronism.

It is consoling to see that Mr. Marriott does not have implicit faith in his new system, for I notice that he proposes to make his quarterly returns at present both on the basis of tons milled and the square fathom. Thus the reader of these reports will have the blessed privilege of ignoring the square fathom returns if he so desires. Mr. Marriott also states (p. 12): "though in discussing these principles I leave out mention of the word 'ton' as far as it is possible to do so, it is of course understood that for the internal operations of the mine under the control of the manager the measurement by this method will always be used to a certain extent in keeping track of his operations." But in spite of this use of the ton-milled costs in the mine and in his quarterly returns, Mr. Marriott calmly announces (p. 10): "Working costs per ton milled, in so far as they concern anyone beyond the local interest of the manager in his details of working, are as dead as the proverbial door-nail." This is a statement that seems to me strangely at variance with the facts, for, as far as I know, the use of the ton as a basis for estimating costs is still world-wide. Moreover, as regards the Rand, I find that in the statement of the results for the six months ending June 30, 1910 (published in the *Financial Times* for July 23, 1910) nothing is used in estimating costs except tons of ore milled. Hence I fail to see what authority Mr. Marriott has for saying that working-costs per ton milled are dead.

I have not seen a clear account of what Mr. Marriott means by his square fathom system, but I gather from his various remarks that he intends to divide the ore reserves into blocks whose gold content can be accurately estimated; this, I take it, is what he means by his cryptic utterance (p. 13) "the ore reserves are, or should be, blocked out into solid units of such a size that their exterior information will give a fairly accurate estimation of their interior contents." Mr. Marriott further states that against each of these blocks "on a stoping plan the value of the gold contents as estimated for the total value of the reserves, should be written in pounds sterling and the square fathomage noted alongside." A separate ledger account is to be kept with each block, and all expenses incurred in extracting the gold—including the due proportion of outside expenses—are to be charged up against the gold obtained. The balance remaining to the credit of this block, after the ore has all been extracted and treated, will be the profit available for dividends. Mr. Marriott gives a much fuller statement, but I think the above fairly represents his views. I fail to see any reason why the square fathomage should be used to get at the value of his blocks. To determine their values the ton unit *must* be used and as this is the case why drag in the square fathom?

Mr. Marriott says that the square fathom has the advantage of giving the manager "the fullest scope possible—scope far beyond that which he has enjoyed in the past—to show what he is worth as a responsible individual." Mr. Marriott does not explain exactly what he means by this phrase, and I decline to guess at his meaning except to assume that it has something to do with working the blocks into which he has divided the ore reserves. Now the extraction of gold from these blocks of ore combines a number of physical operations in the mine and on the surface and I cannot see why there is any occult power in writing the words "square fathomage" on a map that enables a manager to make more profit than if he wrote the words "tons of ore."

A second advantage mentioned is (p. 10) that the "value of gold contents of all your" (Mr. Marriott is speaking to mining managers in Johannesburg) "payable ore reserves is an item on which greater accuracy must be insisted upon than has been the practice in the past."

It is plain enough that the accurate work in the past had nothing to do with the system by which the results of such work were tabulated, and that the results of accurate sampling and assaying can be as well expressed in values per ton as in £. s. d. per square fathom, and hence the square fathom system, from this point of view, has no advantage over the tonnage system.

Still another advantage claimed for the square fathom system is that comparison can be more readily made. Mr. Marriott's words are: (p. 24) "the ore reserves are recorded in terms of the area within which they are included. That area has a distinct relation to the re-

maining claim area of the Company's property, and a direct comparison with this remaining ground can be made on the same basis. The profit now being obtained and to be expected from these reserves is reduced to terms of profit of gold contents per unit of area, and the quarterly returns of all other necessary details are reduced to the same unit. There is thus made a straightforward and progressive means of comparison between the valuation of the mine, the profit being obtained from the current working, the estimated profit from the developed ore reserves, and the relation of the extent of the current operations and development to the prospective life of the mine. These records are thus reduced to one simple, absolute, and easily-comparable basis, which, when it is once understood, will be found to present a much clearer statement of the current operations and future prospects of the Company than has in the past been possible with the more complicated system hitherto adopted."

I understand that this statement (made by Mr. Marriott at the annual meeting of the Village Main Reef, on June 15, 1910) means that it is easier to compare areas in square fathoms than tonnages, but I cannot see in what respect areas are the better unit for making comparisons.

Perhaps it will be plainer to take a concrete case. Let us assume that on January 1, 1909 Block No 1 measuring 2000 square fathoms containing £40,000 in gold; or stated in the usual manner, Block No 1 contained 20,000 tons of £2 ore, or £40,000. If on December 31, 1909 this Block No. 1 measured 500 fathoms and contained £10,000 in gold we should know that ¾ of the block had been worked, but we should know it exactly as well if we were told that the Block contained 5000 tons of ore worth £10,000. And for my part I cannot see that the statement in square fathoms gives any more information than does the statement in tons. What is true of one block will be true of all the blocks and hence true of the whole mine. It does not follow, however, that because there is no need of altering the present system of keeping accounts on the Rand, as regards the ton-milled unit, that Rand mining methods and Rand accounts are perfect, and, in fact, Mr. Marriott has pointed out a number of places where improvements can be made.

One improvement that is needed not only on the Rand but in other mining districts is the adoption of some system by which the capable and hard-working manager shall get credit for his good work. As mines are now run, "a good mine makes a good manager" and conversely the best manager living will gain but little reputation if he is unfortunate enough to have charge of a poor mine. At present the criterion of good management is apt to be low working-costs per ton when in reality maximum profit-making should be the sole test.

Every engineer knows that it is possible to have two adjoining mines, working on similar ore deposits, mine A with high working-costs per ton making a profit, and mine B with low working-costs making a loss. Mr. Marriott concludes from this well-known fact that a mere comparison of working-costs per ton gives no information as to technical skill and business judgment of the management, and seems to think that a comparison of the profits made per square fathom would be fairer to the managers than a comparison made on tonnage costs; but I feel quite sure that if Manager A made £10 profit per square fathom worked, while Manager B only made £2 the average shareholder would immediately conclude that A was the better man, although a careful study of all the conditions might show B to be A's superior in all respects.

It is certainly discouraging for an ambitious manager to be always tied to poor mines and thus never have proper credit for his careful work. In an ideally perfect community it would be possible to classify the mine managers according to the excellence of their work and without reference to profits made by the mine over which they had charge, but I doubt if this idea can be put into practice at present.

Another improvement that ought to be made is the furnishing of the shareholder with an official valuation of his shares and a statement of how this valuation is arrived at. The present practice of throwing an undigested mass of statistics at the shareholder's head is not instructive, and the introduction of the square fathom would give no additional information of value.

In my opinion every annual report should contain an official valuation of the shares of the company concerned. This could surely be done by some independent committee of course unconnected with financial interests of any kind.

A report such as the following: "We value the shares of the So and So Mining Company at £3½" would be worth more to the shareholder than libraries of printed statistics and acres of mining maps. I am so confident of the value of such a system of independent estimates that I take this opportunity of suggesting that such a course should be taken.

W. H. SHOCKLEY.

London, July 27, 1910.

CALCULATIONS OF PERCENTAGE OF RECOVERY

By THEODORE J. HOOVER

IN a recent article* on the calculation of recoveries in concentration operations, the genesis of certain formulæ was given.

Where a = assay of ore
b = „ „ tailing
c = „ „ concentrate
x = tons of ore.
y = „ „ tailing
z = „ „ concentrate

$\frac{100\ c\ (a-b)}{a(c-b)}$ = percentage of recovery.

$\frac{c-b}{a-b} = \frac{x}{z}$ = ratio of concentration.

These formulæ have several applications in practice other than those previously given, as for instance:

In a mine examination it is sometimes necessary to construct tentative figures as to the concentration of the ore. The assay of the ore will be known and a rough panning test can be made for ratio of concentration. A certain percentage of recovery can be assumed. Thus:

a = assay of ore = 4% copper
b = „ of prospective tailing = unknown
c = „ of prospective concentrate = unknown
x = tons of ore = 100
y = „ tailing = unknown
z = „ concentrate = unknown

Assume 80% recovery
Then $a\ x$ = 4 tons of metallic copper
$b\ y$ = 0·8 tons „ „
$c\ z$ = 3·2 tons „ „

y and z can now have values from 0 to 100, b can have any values from 0 to 4 and c can have any value from 0 to say 20% (depending on what mineral carries the copper). However, if we assign a value to either b, c, y or z, the value of the others becomes fixed.

Suppose we assume that c, the assay of the concentrate, will be 20% copper, then

$$\frac{20}{100}\ z = 3{\cdot}2 \text{ tons}$$

$$z = \frac{3{\cdot}2}{0{\cdot}2}$$

z = 16 tons of concentrate
$y = x - z$
y = 100 − 16
y = 84 tons of tailing
$b\ y$ = 0·8

$$b = \frac{0{\cdot}8}{84}$$

b = 0·95% copper

Our figures then are
Assay of ore = 4% copper
Tons „ = 100
Assay of tailing = 0·95% copper
Tons „ = 84
Assay of concentrate = 20% copper
Tons „ = 16

We can now apply freight and treatment charges, and then proceed with the estimates of mine valuation.

In a case where it was important to learn something of the work in a mill where the management was very secretive, the following data were available:

Surreptitious samples of the tailing assayed 1·4% copper
Surreptitious samples of the concentrate assayed 15% copper

By counting, from the hotel veranda, the sacks of concentrate shipped per week, it was possible to obtain a fairly close estimate of the concentrate produced namely, 60 tons per day.

A question put to the mill-man elicited the information that 300 tons per day was being treated; this was also checked by counting the buckets on the tramway from the mine.

Assay of ore = unknown
„ „ tailing = 1·4% copper
„ „ concentrate = 15% copper
Tons of ore = 300
Tons of concentrate = 60

$$\frac{x}{z} = \frac{c-b}{a-b}$$

$$5 = \frac{0{\cdot}15 - 0{\cdot}014}{a - 0{\cdot}014}$$

$5a - 0{\cdot}07 = 0{\cdot}15 - 0{\cdot}014$
$5a = 0{\cdot}206$
a = 4·12% copper
$a\ x$ = 12·36 tons copper per day in ore
$c\ z$ = 9 „ „ „ „ concentrate
Percentage of recovery = 72

* *Engineering and Mining Journal*, June 11, 1910, p. 1234. *The Mining Magazine*, July 1910, pp. 19 and 74.
In the articles in *The Mining Magazine* for July we used x, y, a, b, in connection with the ore and concentrate as these are the two most important items. Mr. Hoover however finds by experience an advantage in using x, z, a, c, for these, as the c fixes the mind on the word 'concentrate.'—(EDITOR.)

Later when access to the mine was secured the mill and mine records showed an actual recovery of 70·7% for the month during which the week's observations were made from the hotel veranda. The ore for the month, however, had an average assay of 4·5% copper.

The books showed:

Tons of ore for month 7511 = x
„ concentrate 1602 = z
Assay of ore for month 4·5% = a
„ concentrate 14·91 = c
„ tailing 1·37 = b

Theoretical recovery $= \frac{100\,c\,(a-b)}{a\,(c-b)}$

$= \frac{(100)\,(14{\cdot}91)\,(4{\cdot}5-1{\cdot}37)}{4{\cdot}5\,(14{\cdot}91-1{\cdot}37)}$

$= 76{\cdot}6\%$

Actual recovery:

7511 @ 4·5 = 337·995

1602 @ 14·91 = 238·8582

238·8582 ÷ 337·995 = 70·7% recovery

The difference between 76·6% and 70·7% or 5·9% represented the losses and inaccuracies, and is not worse than occurs in many cases.

A famous mine not a thousand miles from Melbourne publishes an interesting annual report. The following figures were on one occasion given, suppressing the information as to the tonnage and assay of the tailing:

Tons of ore = 237,265
Assay „ = 11·5 oz. silver, 16·3% lead, 18·7% zinc
Tons of concentrate = 43,493
Assay „ „ = 29·7 oz. silver, 59·8% lead, 10·3% zinc

The tons of tailing can be determined by subtraction and the assay thereof by calculating the contents and then dividing, but it is easier to apply the formula:

$$\frac{x}{z}\quad\frac{c-b}{a-b}$$

$$b = \frac{33{\cdot}09}{4{\cdot}46} = 7{\cdot}4 \text{ oz. silver}$$

$$b = \frac{29{\cdot}2}{4{\cdot}46} = 6{\cdot}54\% \text{ lead}$$

$$b = \frac{91{\cdot}8}{4{\cdot}46} = 20{\cdot}6\% \text{ zinc}$$

Multiplying according to the old system and dividing by the tons we find that the results are correct within the limits of the slide-rule.

In another mine not far away the following figures were given:

	Tons	Lead %	Silver oz.	Zinc %
Ore	46,301	12	9·1	10·1
Concentrate	5,924	61	29·3	5·5
Jig-tailing	17,672	4·3	4·9	8·6
Table-tailing	17,085	3·5	5·7	12·0
Slime	5,618	10·6	11·0	13·8

For purposes of subsequent treatment of these residual products by flotation processes it is desirable to know what will be the probable assay of the combined jig-tailing, table-tailing and slime. This can, of course, be ascertained by multiplying the tonnage of each by its assay to get the metal contents, adding together the metal contents and dividing it by the total tons. In order to show the usefulness of the formula this old standard method is given below and the same result obtained by the formula. I spent two hours on the first calculation, whereas the second was accomplished in ten minutes.

Ore	46301·1 tons	× 12%	= 5556·132 tons Pb
	46301·1 „	× 9·1 oz.	= 421340·01 oz. Ag
	46301·1 „	× 10·1%	= 4676·4111 tons Zn
Concentrate	5924·1 tons	× 61%	= 3613·701 tons Pb
	5924·1 „	× 29·3 oz.	= 173576·13 oz. Ag
	5924·1 „	× 5·5%	= 325·8255 tons Zn
Jig-tailing	17672·8 tons	× 4·3%	= 759·9304 tons Pb
	17672·8 „	× 4·9 oz.	= 86596·72 oz. Ag
	17672·8 „	× 8·6%	= 1519·8608 tons Zn
Table-tailing	17085·6 tons	× 3·5%	= 597·996 tons Pb
	17085·6 „	× 5·7 oz.	= 97387·92 oz. Ag
	17085·6 „	× 12%	= 2050·272 tons Zn
Slime	5618·6 tons	× 10·6%	= 595·5716 tons Pb
	5618·6 „	× 11 oz.	= 61804·6 oz. Ag
	5618·6 „	× 13·8%	= 775·3668 tons Zn

Then add, to get total tons of metal in total residual products:

	Lead	Silver	Zinc
Jig-tailing	759·9304	86596·72	1519·8608
Table-tailing	597·9960	97387·92	2050·2720
Slime	595·5716	61804·60	775·3668
Total	1953·4980	245789·24	4345·4996

Then add the contents of the concentrate as a check on the figures:

Lead	Silver	Zinc
1953·498	245789·24	4345·4996
3613·701	173576·13	325·8255
5567·199	419365·37	4671·3251

These last figures compared with the contents of the original ore show a commendable lock-up of a year's results.

Now the total of residues is:

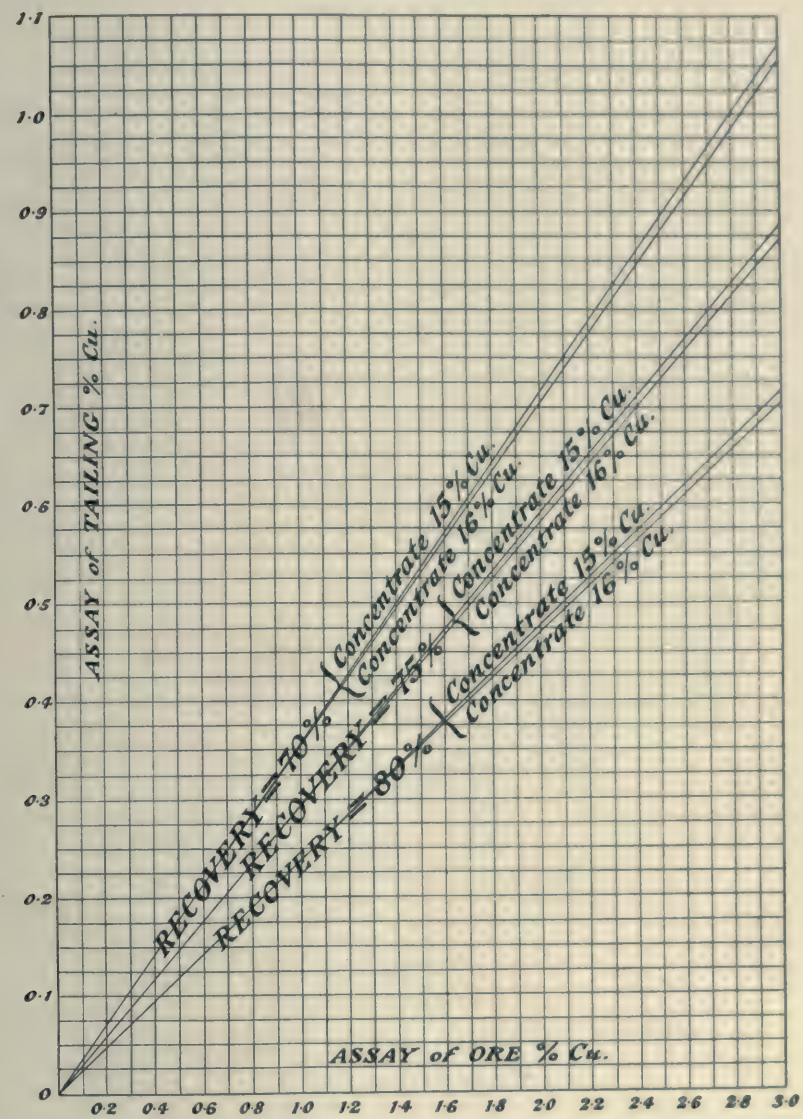
Jig-tailing	17672·8
Table-tailing	17085·6
Slime	5618·6
Total	40377·0

By applying the formula

$$\frac{x}{z} = \frac{c - b}{a - b}$$

For the lead assay:

$$\frac{46301{\cdot}1}{5924{\cdot}1} = \frac{61 - b}{12 - b}$$


ASSAY of TAILING % Cu.
ASSAY of ORE % Cu.
RECOVERY = 70% { Concentrate 15% Cu.
Concentrate 16% Cu.
RECOVERY = 75% { Concentrate 15% Cu.
Concentrate 16% Cu.
RECOVERY = 80% { Concentrate 15% Cu.
Concentrate 16% Cu.
0 0·1 0·2 0·3 0·4 0·5 0·6 0·7 0·8 0·9 1·0 1·1
0·2 0·4 0·6 0·8 1·0 1·2 1·4 1·6 1·8 2·0 2·2 2·4 2·6 2·8 3·0

Now divide the contents by the tons:

1953·498 ÷ 40377 = 4·8% Pb
245789·24 ÷ 40377 = 6·1 oz. Ag
4345·4996 ÷ 40377 = 10·8% Zn

which we know from subsequent investigation fairly represents the average value of the combined residues.

$$7{\cdot}816 = \frac{61 - b}{12 - b}$$

$$93{\cdot}792 - 7{\cdot}816b = 61 - b$$

$$6{\cdot}816\,b = 32{\cdot}792$$

$$b = 4{\cdot}81\%\ \text{Pb.}$$

For the silver assay :

$$7{\cdot}816 = \frac{29{\cdot}3 - b}{9{\cdot}1 - b}$$

$$b = 6{\cdot}13 \text{ oz. Ag per ton}$$

For the zinc assay :

$$7.816 = \frac{5{\cdot}5 - b}{10{\cdot}1 - b}$$

$$b = 10{\cdot}77\% \text{ Zn}$$

All these calculations were worked twice, once by hand and checked with the slide-rule.

The above figures for tonnage call for some attention. The tons of ore and the tons of concentrate were probably obtained with fair accuracy by weight. But what shall we say of the other figures, which are given to tenths of a ton. It may be taken that the assays are fairly accurate, for if even the arithmetic average of the days' runs be taken the error will not be big enough to vitiate results. It is safe to say that the jig-tailing, table-tailing, and slime were not weighed. They may have been measured by survey and calculated from cubic contents. When the difficulties of moisture and losses are taken into account, the accuracy of the results is noteworthy.

Based on the above formulæ certain tables can be constructed for the use of the staff, so as to give graphically a clear idea of the result of a shift's work. As an example let us assume that samples are taken of each shift's work ; that the material is a simple concentrating ore assaying less than 3% copper ; that recoveries are never lower than 70% nor higher than 80% ; that the concentrate never assays higher than 16% copper nor lower than 15% ; these are all assumptions that could fit a case.

Taking the formula :

$$\text{Percentage of recovery} = \frac{100\ c\ (a - b)}{a\ (c - b)}$$

and writing it as a simple equation without the percentage we have

$$R = \frac{c\ (a - b)}{a\ (c - b)}$$

where R is a constant which is a decimal part of unity. Then by transformation :

$$b = \frac{a\ c\ (1 - R)}{c - R\ a}$$

By giving a various values and taking values of R and C as above indicated we can plot a series of curves as in the diagram on page 121. These are of great use. Having done this let us suppose the shift samples assayed :

Ore..... 2·6% copper
Tailing..... 0·75 „

By reference to the co-ordinates we find that the point (2·6) (0·75) falls just above the curve for 75% recovery and 15% grade. By making a large wall-chart and plotting curves at intervals of ½% recovery between 70% and 80% the results of a shift's run can be read at a glance with a considerable degree of accuracy. Attention should be called to the fact that any variation in the assay of the concentrate between 15% and 16% has little influence on the curve ; in fact, for over half of its distance the y co-ordinate of the points is within unity whether the assay is taken as 15% or 16%. Near the end of the curve the difference becomes just sufficient to plot the two curves separately with comfort. On a mine where the average assay of the concentrate over a long period is known it would be sufficiently accurate to plot the curves with a fixed constant. This chart would also show at a glance any inconsistency in the assay results, as for instance, if the assayer reported ore 2·9%, tailing 0·55%, concentrate 15·2%, he may be suspected of inaccuracy unless the alternative assumption is made that there has been a marked improvement in recovery to much above 80%. The use of this chart constructed on assumptions of theoretical recovery has a salutary influence on the members of the staff when once they understand its import ; they are on the look-out for losses on the one hand and inaccuracies in method on the other.

Mining Prospects in Fiji.—A year or more ago the New Zealand government sent N. D. Cochrane to Fiji to help the local authorities in the investigation of possible ore deposits. When he arrived he found that a gold mining fever was prevalent and that over 50,000 acres had been staked by prospectors. He made a geological examination and found that though fringed with reefs, the islands were not coral islands, but contained many recent volcanic rocks. The character and age of these rocks he found to be similar to those of the Thames peninsula in the northern island of New Zealand. Altered andesite similar to that at Waihi, and mica andesite like that at Egmont are easily identified. As these rocks are geologically young, they have not been subjected to much denudation, so that the prospects for placer mining are not promising, though some small deposits have been found. On the other hand, there are many auriferous outcrops but none of them are sufficiently rich at surface to encourage men without capital.

MINING IN NICARAGUA

By T. LANE CARTER

THIS is not a political journal, of course, but when I treat of mining in the Spanish American countries, especially Central America, I find that politics play so important a part in the economic possibilities that I feel constrained to start with the political aspect even when writing for a technical paper. The turbulence and uncertainty of the Central American republic is known throughout the civilized world. Nothing save lack of efficient government has withheld capital from a part of the world so peculiarly blessed by nature both in mineral and agricultural wealth. Not all the States have suffered equally from misgovernment, and the consequent lack of confidence, for Costa Rica and Salvador are far in the lead both in wealth and stability. The most backward, the most unfortunate of all in recent years, has been Nicaragua, during the regime of the dethroned despot-president, Zelaya.

It would take too long to explain how the policies of this man have held back Nicaragua. By the granting of concessions of all kinds and by an outrageously high tariff, Zelaya did much to hinder the development of mining. But he has gone now, even as Castro disappeared from Venezuela, and the greatest obstacle to progress has vanished from Nicaragua.

The mining industry of the country has advanced in spite of Zelaya, and this fact can be considered one of the greatest proofs of the possibilities of the mineral wealth of this small republic. Capital is notoriously timid, and too often it has been stated that given even a rich mine in Nicaragua, it would be impossible to make a success on account of adverse political conditions. Some people have even imagined that the tenure of mining property in Nicaragua was so uncertain that there was always a danger of losing the property. This is a gross exaggeration. What the bad political conditions have done is to keep sufficient capital out of the country. Those men who have gone there and acquired mines by the due process of law, having their claims approved both in Nicaragua and by their own governments, have found out that mining claims thus registered are perfectly safe. Especially true is this of English companies or individuals, for the foreign policy of protection to citizens of the British Empire is so thoroughly appreciated even in a country like Nicaragua, that the Government there is careful not to tread on the tail of the British lion, even when that tail is represented by a mining claim. It looks as if the United States will follow the example of England, and insist on the same protection to its citizens. I asked a gentleman well acquainted with the political conditions in Central America for his views on the subject and he told me that provided the titles to mine property were clear (and of this you must be certain) and properly approved, he would feel as safe in his ownership as in any other country. Some people have got into trouble through ignorance of the mining laws.

While the political conditions have kept out capital, and interfered with the operation of mines, the numerous failures of the past cannot with justice be attributed to the Government. The great success of the mining industry under Paul Kruger's government in the Transvaal shows what can be accomplished by able men under a regime as unsympathetic to mining as was Oom Paul's. The analysis of failures in mining, as in other pursuits, is often illuminating, and one could write an instructive article on this phase of Nicaraguan mining. At present I can only briefly refer to it.

In the first place, mining has too often been conducted there as a side issue with the merchants. Their idea was to create a demand for merchandise, and if they could sell enough goods to the property, then they would make profits from the trading as long as the mine paid expenses. Secondly, the wrong kind of men have gone into the mining business. There have been too few skilled prospectors, and too many broken-down clerks out in the wilds looking for mines. The greatest success in Eastern Nicaragua has been attained by a capable miner who knew when he had a property, and how to go about developing the mine economically after he found it. Moreover, the dearth of capital has been a great drawback to the development of the country. The task of opening up some of these prospects away off in the wilderness has seemed almost as impossible, when one considered the small amount of cash available, as a man picking himself up by his own boot-straps. That mining has gone ahead in Nicaragua in spite of all these hindrances is a proof of the possibilities of the region.

The mining laws of Nicaragua are excellent,

especially for the poor man. Direct taxation is not excessive ; it is the indirect taxation that is heavy, due to high duties on food-stuffs. All mining machinery is let into the country free.

Parts of Nicaragua, along the coast, in the low swampy tracts near some of the rivers, are unhealthy, but when you reach an altitude of 600 to 3000 ft. above the sea, the climate is not only salubrious but delightful. Properties situated in the highlands are blessed with one of the best climates in the world. Those in the lowlands have a constant fight against malarial fevers. While I had the bad luck to have the only serious illness of my life in Nicaragua, this misfortune does not blind me to the fact that, on a whole, the climate of the Republic is satisfactory.

The history of mining in this part of Spanish America did not commence yesterday. For long years past gold has been shipped from the country, but modern mining dates from 1858 to 1860, when miners on their way to California were attracted by the gold prospects. Off and on, mining for the precious metal has continued ever since.

On the eastern side of Nicaragua the mining is of more recent date, being a growth of the past twenty years. Today the best known district is the Pis-Pis district, near Honduras, where the Bonanza, Lone Star, Trinidad, Constantia, and Siempre Viva properties are situated. The visiting engineer is struck with the low working cost attained on the mines now producing. In spite of the Government, in spite of transportation difficulties, the cost per ton today in Eastern Nicaragua is only from $2 to $3 per ton. When it is remembered that the plants are all small, none of them being of a capacity of more than 200 tons per day, the working cost seems very low. Were the plants larger and better handled, the cost per ton could be reduced still further.

The reasons for these low figures, in a region where at first sight one would expect to find costs high, are obvious. In the first place, the majority of mines have sufficient energy from water wheels, or hydro-electric power, to run all the machinery. The cost for power, which in many other countries is so high, is here almost nothing. The veins are frequently wide, from 30 to 80 ft. ; stoping and development are therefore cheap. The rock is favourable for blasting, so that the cost for explosives is small. With patience and perseverance good results are obtained from the native labour. The ore is easy to crush, and the consumption of cyanide is not high. As the mining is done chiefly through adits, hoisting and pumping cost nothing. Of course, during the short dry season some of the streams run low, and on some mines it becomes impossible to generate power enough to run the machinery. If it is desired to run the mill all the year round on such properties, an auxiliary steam-plant is necessary. Provided steam is required for only six weeks in the year, there is sufficient wood to last a long time.

The rainfall is abundant. The driest months are February, March, and April, and if the engineer has much travelling ahead of him this is the season of the year to accomplish it. Travel during the rainy reason is almost impossible. The rainfall varies considerably at different points : At Greytown, on the coast, the precipitation is stated to be nearly 300 in. per year ; at Bluefields, 180 in. ; in the Pis-Pis district, 120 in. On some properties there is an abundance of water all the year. The best situated mine in this regard is the Siempre Viva in the Pis-Pis district, which owns one of the finest waterfalls in the country.

The necessity for acquiring water-power, even if fifteen or twenty miles distant, has too often been neglected in Nicaragua. A small plant starts up, with a boiler and steam-engine. If the prospect opens up well, and steam is used entirely for generating power, the wood in the immediate neighbourhood is soon consumed, and fuel must be bought from a distance. Those who have tried it know the difficulty and expense of handling timber in tropical forests.

Transport is one of the hardest problems. Were it not for the numerous rivers, which enable the miners to bring freight by water to within a comparatively short distance of the mines, the problem of transport would be economically impossible. If Nicaragua, for instance, were as dry a country as South Africa, it is certain that not a single mine could run at a profit, unless a railroad were built from the coast to the mining districts. Today there is no railroad in the eastern part of Nicaragua, but, on account of the rivers, properties have been opened up and are now producing, because this water-transport makes it possible to handle the freight.

The heaviest expense is incurred when the freight must be carried through the forest to the mine. To give a concrete example, I know a mine which in the dry season was forced to bring its freight from a town 18 miles distant, instead of landing near-by, which was done when the river was high. The road from the town to the mine was partly in flat country, partly in hilly country. To bring 100 lb. of freight over this path of 18 miles cost more

than to transport the same weight from New Orleans to the town, situated on one of the rivers, 110 miles from the sea.

Freight on the rivers is handled by means of 'pit-pans' or huge canoes made from great trees. It will probably occur to the reader that these canoes, paddled up-stream by 7 to 15 Indians, could be replaced by small motor boats. This idea is gaining ground, and before long the Indian and his canoe will vanish. It is to be hoped that the mining development will soon be so brisk that the traffic will justify a railroad from the coast to the mining districts.

The rivers are diversified by rapids. Many of these the Indians are able to climb over, although now and then a boat is upset and the cargo lost. To be in a canoe and mount these rapids with the Indians is a feature of Nicaraguan life that mitigates the monotony. Some of the rapids are too much for the Indians, and they are compelled to take out the freight and carry it some distance up-stream until the obstruction is passed.

Contractors handle practically all the freight on the rivers. The skill of the Indian canoemen in managing their craft in these sinuous rivers is one of the marvels that the traveller never forgets. The Indian is born and brought up in a canoe. For generations his ancestors have spent much of their lives handling the paddle, so that it is not surprising that these red people, both men and women, are so expert in their boats.

The expense of transport varies widely. In the Wawa district, near the coast, where schooners can come to the mines, or at the Topaz mine, up the Escondido river, where a steam-boat can approach the mine, the cost of handling freight is insignificant. For mines unfavourably situated the cost is 6½ to 7 cents per pound.

In the transportation from the river to the mine, oxen and pack-mules are employed. There are no roads in Eastern Nicaragua, only paths through the forest, and the freight must be carried on the back of animals, or else dragged along the ground on sleighs. Flour, in barrels of 100 lb., is carried on the backs of the beasts, a usual load being two barrels, having a total weight of 200 lb. Heavy pieces of machinery are dragged by oxen. To handle such freight expeditiously and cheaply under unusually hard conditions requires skill and experience. To the uninitiated it would seem a hopeless task to transport large pieces of machinery through these tropical forests. The heavy freighting on the rivers is best done during the wet months, when the streams are high. An effort is then made to bring up the 'spares' for the mill, and a large supply of merchandise, so that the traffic during the dry season may be reduced to a minimum.

Seeing how expensive it is to handle freight, it is to the advantage of the miner to reduce the amount in every way possible. For this reason as soon as an owner feels convinced that he has a property that will last, he makes a clearing in the forest in order to grow his own produce. The soil of Nicaragua is extraordinarily fertile, but on account of the insects, such as ants, it is difficult to bring to maturity some plants that start off with much promise. One of the sights of the country is to watch an army of ants on a raiding expedition. When they attack some favourite plant or tree, nothing is left afterwards save the twigs and branches. I have known them to eat the seeds of imported shrubs soon after they were planted. For this reason on mines in the wilderness it is best to cultivate those products only that are certain to come to maturity, and not the tender plants of other climes that cannot withstand the assaults of the insects. Experience shows that the following products can be relied upon: banana, plantain, corn, cassava, pineapple, cocoa, sweet potato, and sugar cane.

On one mine the manager has erected a small ice-plant, and in this way he is able to "kill his own meat." On account of the climate beef cannot be kept long, but with an ice-plant it is practicable to kill a steer and keep the beef for days. In the tropics the less tinned beef consumed the better. The use of an ice-plant is not only better for health, but it is far cheaper.

There has been no trouble about labour. If the country goes ahead as it should, the demand will soon exceed the supply but by going farther afield other supplies of labour may be found. The men now employed are of four classes, namely, whites, negroes, Indians, and Spaniards. There are a few foreign whites, their work being solely supervision, as managers, engineers, assayers, and surveyors. The negroes who are natives of Nicaragua and Jamaica call themselves 'creoles.' As few are used as possible; they are unpopular, having a reputation for insolence and laziness. The Indians are masters in handling the 'pit-pans' or canoes and have this work entirely in their hands. As miners they are failures, but they do fair work as hunters, shovellers, and truckers. They seem to love hard work as little as in the sixteenth century, when the Spanish adventurers first forced their fathers into slavery.

Most of the work is done by the 'Spaniards,' as the Nicaraguans are called. When properly handled these men do excellent work, being more efficient than the natives of Mexico. For one thing, there is not so much time lost through *fièstas* and holy days, as in Mexico. The 'Spaniards' come from the more populous interior, they work for a year or so, and then return home. They work well even on 'day's pay,' but, of course, do best when on contract. It is not wise to engage labourers from one class only. A proportion of 50% 'Spaniards,' 25% negroes, and 25% Indians is a good arrangement. The three classes prefer to eat and sleep apart.

The wages varies from 40 to 80 cents for the Indians. The Spaniards receive from 60 cents to $1 (U.S.) per day when working on day's pay. Expert miners on contract earn from $3·75 to $4·75 per day. There is no machine-drilling, all the driving and cross-cutting being done by hand-labour. The introduction of air-drills, on mines large enough to warrant it, will be a big advance.

Feeding the workmen is in some instances as costly as the wages, especially on those mines that import rice, beans, and flour from the United States. Each mine of any size has a store (the profit from which is considerable), where the men can purchase such luxuries as tobacco and sardines.

Nicaragua is one of the most difficult countries in the world for the prospector, and were it not for the numerous streams that expose the geological formation, it would seem almost impossible to discover a gold mine. The Spaniards and Indians are excellent prospectors, and the foreigner can do nothing better than go with one of them when searching for a gold deposit. After prospecting in an open country like South Africa, the prospector feels lost when he first attempts to look for precious metals in Central America. The impenetrable forest, the thick

BONANZA MINE. BRUSH CLEARED IN PREPARATION FOR OPEN-CUT WORK.

MILL BUILDINGS OF THE LONE STAR MINE, NICARAGUA.

undergrowth, the drift that covers the formation, all discourage him so at the start that he feels as if he would have more chance to find a needle in a hay-stack than a gold mine in such a setting. Experience is a great teacher, however, and by degrees he learns the secrets of the tropical formations, as he has mastered the mysteries of other climes. Honour to the man who discovers a gold mine in the wilderness of Nicaragua! He deserves all that's coming to him.

One of the weakest aspects of gold mining in Eastern Nicaragua is the poor metallurgy. There is not an efficient plant in this part of the country. The extraction varies from 35 to 80%. One mine claims to get 87½%, but I doubt it very much. With the ores such as I saw, an extraction of 90% should be readily obtained. Much of the lack of profit is due to the inefficiency of the plants.

The question as to what will happen below the water-level is a vital one in Nicaragua, as elsewhere. Little or nothing is known yet, for scarcely any ore has been mined from the deeper zone. Possibly Transvaal history will repeat itself in Nicaragua. In the early days of the Rand, while mining was confined to the oxidized zone, many engineers shook their heads and predicted disastrous failure when the sulphide zone was penetrated, but to-day on the Rand they get an extraction 90%, and more, from ore mined at a depth of 4000 feet.

On some of the larger properties in Nicaragua there is sufficient ore in the big veins even above the water-level to make successful mines. Whether there will be a rapid impoverishment in depth or such an increase in the sulphides of lead, zinc, and copper as to make the deposit economically unprofitable, remains to be seen.

Photographs of two of the most promising mines of Eastern Nicaragua are shown herewith, namely the Bonanza and Lone Star. The story of the Bonanza mine is an interesting one, and is worthy to be added to the long list of the thrilling adventures that have made the history of gold mining so fascinating. Joseph Lapierre, a Canadian, who owns the mine, has made it what it is today, and to his untiring energy is due the successful development of this property. No one can visit the Bonanza, see the large veins and the favourable working conditions, without realizing that here is a big gold mine. It is probable that this property will be sold soon for perhaps a quarter of a million pounds.

The Lone Star mine, next to the Bonanza, is another promising property. The chief feature of interest, besides the huge vein, is the splendid water-power available. On the left of the illustration can be seen the pipe-line, which conveys the water to the Pelton wheel in the mill.

What of future mining in Nicaragua? I defy any one to go, as I have, from the borders of Costa Rica to Honduras, and see the large areas of mineralization and numerous prospects, without forming a favourable idea of the mining possibilities of this portion of Spanish America. How long it will be, I do not know, but some day Nicaragua's mineral wealth will be successfully developed, and bring fortune to those who exploit it. Capital may be too timid to enter this territory just now, but eventually conditions will improve and the mines will be opened up. I cannot help thinking that with the advent of the Panama Canal an era of prosperity and stability will come not only for Nicaragua but the whole of Central America. Mexico and the United States have already done much for the peace of these turbulent States, and I believe the time is near when the trade of the world will become so important that the small republics will be compelled to keep the peace. With a satisfactory government and the confidence of capital, the development of Nicaragua and the rest of Central America will be as remarkable as that of Mexico.

What the country most wants — after a stable, honest, and efficient government — is ample capital to develop her mineral resources, and capable men to direct such development. In no country in the world is caution and skill more needed than here, where a man who does not know his business can fritter away hundreds of thousands of pounds and accomplish nothing. From what we know of this Republic today, the mines will be large low-grade propositions. Mining of this kind requires plenty of capital for modern appliances, and skill in using them.

The Ullrich Magnetic Concentrator is to be tried on a large experimental scale at the Dunderland iron ore mine in Norway. These deposits have been developed on a gigantic scale and vast sums spent on dry concentrators, all to no avail. The ore consists of low grade hematite and magnetite and contains an undesirable proportion of phosphorus. In the Ullrich machine the separation is done under water, between electromagnets below, and a revolving disc containing concentric circular poles above. The iron is attracted to the revolving poles out of the stream of pulp and as the disc revolves and carries the particles out of the field of the electromagnets, a downward current of water washes the particles off and delivers them into another receptacle.

RECOLLECTIONS OF MINE FIRES

By WILLIAM CROSLEY

THE notes in the February number of the *Mining Magazine* upon coal-dust experiments in Austria-Hungary with reference to explosions of fire-damp recalled to my mind the circumstances that first awoke in me actual interest in the coal-dust theory, though it has been under discussion and experiment since the demonstration of Faraday in the early part of the last century.

It was in the course of the inquest upon the victims of the Pemberton colliery explosion in 1877. Thirty-six persons lost their lives, including all the certificated heads of management and responsibility. The circumstances may be understood from the following brief description. The air went through the mine in practically one continuous current; as there were few working faces, the current of air was copious. Immediately after the explosion our first attempt to descend was made by the upcast shaft from which the seam was worked, but meeting some temporary obstruction we had to return and then go down the intake. Upon reaching the main level, however, we found this converted into a sluggish return instead of being the usual active intake, as the air was rushing round the short circuit through the doors, now blown down, on the main level.

By this time there were seven in the party, and though the proper course was undoubtedly to have somewhat restored the ventilation, we started up the main level toward the far end. Three of us were sent back to the fresh-air station to get our lamps re-lighted and when we went after the others we found them about 80 yards up the level. Three of the four were dead; the fourth, a fireman, recovered after two days of unconsciousness. It is clear that the return air on the main level was getting worse every second; had it been as bad when they went in as when we found them, they could not have got as far as they did, for we had the greatest difficulty in getting them back the short distance to the fresh air. Subsequently, of course, the ventilation was restored and on reaching the nearest workings a fire was found to be active but unapproachable, so that after much deliberation by the council of engineers, now arrived from all parts, it was decided to brick up the main incline and the level off it, by a diagonal stopping, as it was quite clear that the men could not be alive.

The building of this stopping, consisting of two 9 in. walls with about a 2 ft. space between them, filled with sand, was an arduous piece of work and was done by constant relays of men working a few minutes at a time. An iron pipe and valve were built into the stopping and communicating with the inner air and a thermometer was kept in the pipe and read periodically. About a fortnight later when the temperature showed an abatement, the stopping was broached and an entrance effected. This effort was made earlier than it would otherwise have been as the inquest could not be closed until the seven poor fellows who remained bricked in their fiery tomb were got out; and the district was in the state of unrest usual at such sad times.

I do not recollect the temperature registered but I know it was barely supportable and had we not carried on our backs fire-extinguishers squirting water and carbonic acid and promptly dealing with any spot in the act of rekindling, there is no manner of doubt the place would have lighted up again.

In this level, the timber and brattice were burned and the coal had been well alight; doubtless the origin of the explosion was here. In the bottom coal at the face of Rutter's level was a blown-out shot, and about this shot and the coal-dust lengthy if not exhaustive arguments ensued. It was in consequence of the discussion at the Pemberton inquest that Henry Hall conducted his experiments upon the effect of blown-out shots upon the issue of gas from an adjacent coal-face. He argued that the forward thrust given instantaneously by the blown-out shot left the contiguous faces of the coal for that brief space of time *in vacuo* or partly so, and allowed an abnormal issue of gases. The conclusiveness of Mr. Hall's experiments was acknowledged by Sir Frederick Abel ten years later.

Fortunately it is not often in metal mining that we are called upon to fight fire, but it is not altogether unknown; a sad instance with fatal results (again to the leading members of the staff) occurred not so very long ago on the Rand.

The only serious instance in metal mining in my own experience was at the Abbontiakoon mine, in October 1905, to which I was called by the manager, J. Berry. The interest

attaching to this fire arose from two circumstances: The surface was riddled by ancient workings making the absolute sealing of the mine a matter of impossibility. The main shaft (an incline at an angle of about 35° and 870 ft. long) for more than two hundred feet from the surface was in broken ground and thousands of cubic feet of cordwood filled the spaces behind the lagging. Some of these old workings allowed the passage of fresh air and others, doubtless through the abnormal currents set up, poured out carbonic acid gas in sufficient quantities to be dangerous to the workers. The timbers of the main shaft were tarred and the smoke was unusually pungent. The fire originated low down, but at first it was not known where, and it was important to save the top 200 ft. if possible. The accompanying diagrams of the mine will make the course of events clear.

When I arrived, on the day following the outbreak, all entrances were closed as tightly as possible; the main shaft and the vertical shaft, which communicated with the incline, were sealed by rails and sheet-iron covered with earth, and all the entrances by tunnels and adits communicating with the upper levels were boarded and clayed over. An attempt, only prompted by impatience, and to which I am bound to say I dissented, was made that day to enter by Gilbert's adit (see plan) but not only did the evidence of vigorous rekindling become apparent at the top of the main shaft and vertical, but our position in the first level south near the boundary shaft became untenable by reason of poisonous gases, so that wiser councils prevailed and the sealing up was made as good as possible to stand for a fortnight, at the end of which interval I returned and we began to fight the fire, systematically. In place of the first covering of the main shaft, closely fitting doors were fixed on the first set of the main shaft and clayed over. This was no light work, as the gas knocked us out quickly; many were the relays of workers before it was accomplished, and all this temporarily revived the fire. The doors, however, were a more effective seal.

The problem was first to locate the fire, and then if possible reach it by laying pipes and hose through one of the south levels to quench it with water. We were quite ignorant as to what point in the shaft the fire had reached, so any re-opening of the main shaft was out of the question until we could be sure that the then existing seat of fire was about or below the vertical shaft.

In order to divert the circulation of air in the main shaft about the foot of the vertical, a powerful jet of steam was constructed and placed in a short rise to surface off the first level south, and not far from the boundary shaft. Closely fitting doors were built in this level on the boundary shaft side, so that all the pull should come from the south or deeper workings. We hoped by this means to have enough air to go with us down the 'boundary' and explore each level in turn to the main shaft. The current, however, was not strong enough and gas constantly crept up the 'boundary,' so that we had to establish independent ventilation and a central brattice in order to get to the second and third levels. So strong was the carbonic acid that candles would not burn a foot or two below the end of the brattice as we advanced, and thus every foot had to be won.

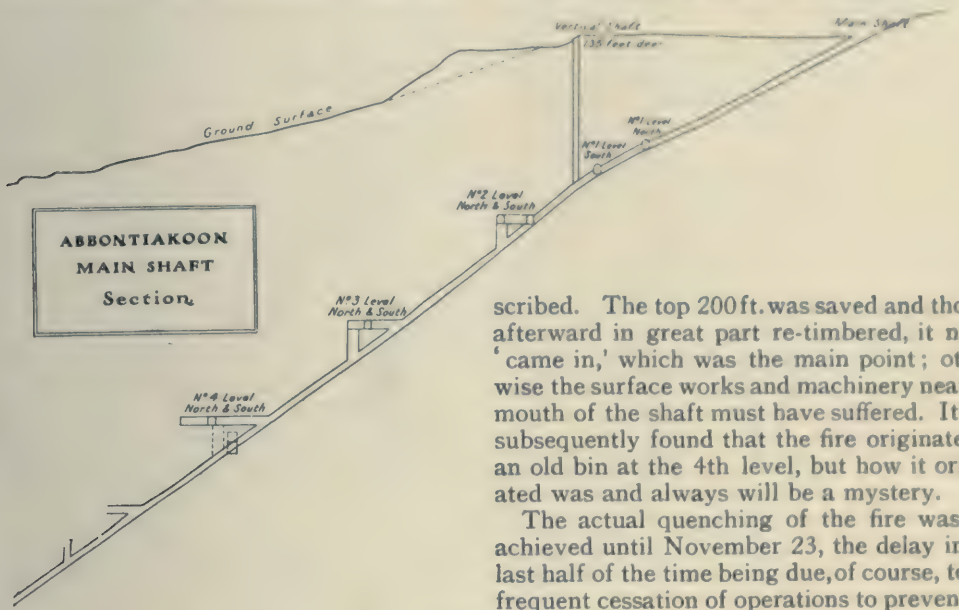
As we noticed that every time we opened the boundary shaft for work the heat increased in the main shaft, we only worked short spells and shut down.

While this was being done a gigantic hydrant was made out of 10 in. pipes bolted together with a rose or spray at the end, which was laid in a skip. This was hastily passed through the doors on the main shaft and lowered length by length through a hole in the door, replaced, until nearly 200 ft. of water-column was let out and communicated through a valve with a reservoir on the hill. This was played at intervals at full bore as long as the reservoir lasted each time and thus provided a means of holding the fire at least below that point.

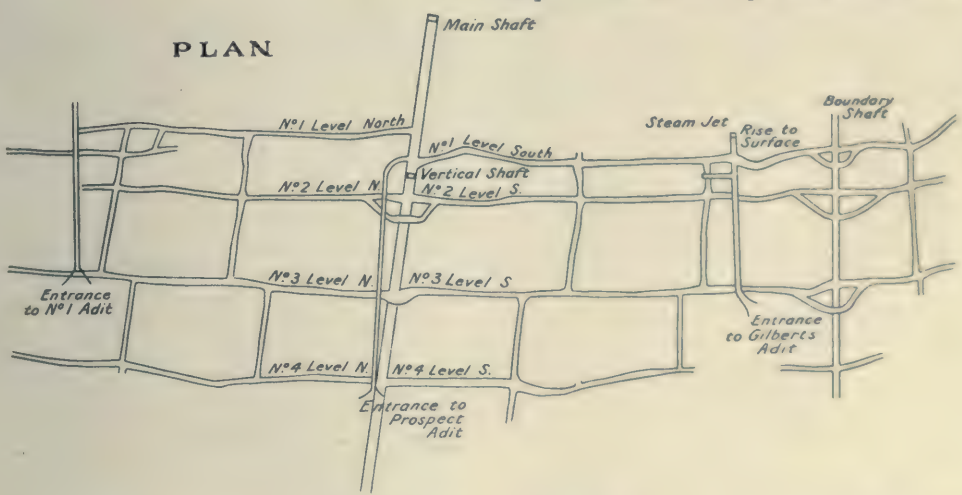
After clearing the second and third levels and their stopes (not shown on plan) of foul air by aid of the jet and boundary shaft we were in turn able to reach the main shaft at each of these levels to find that the fire had spent itself and left a chaos of heavy falls up to beyond the second level, at least. To reach the main shaft by the main return on the first level south was out of the question. The only way to get to the main shaft near the top levels was by the 'Prospect' and 'No. 1' adits, but this had the disadvantage of bringing fresh air across the main shaft. Whatever was to be done now had to be done quickly. We shut off the steam jet and through the Prospect adit we reached the main shaft opposite No. 1 level south only to find it blocked. We could hear the fire roaring but could not say whether it was above or below us, so we quickly went out and closed the mouth of the entrance; we then entered by the No. 1 adit, and got to the main shaft at the No. 1 level north, finding the shaft intact at that point; below us it was blocked by falls and timber, but our hydrant was near by and intact. Thus we had ascertained that the fire

was at or near the No. 1 level south and the foot of the vertical shaft. This was all we wanted to know; the next step was clear and was promptly taken. We had already got all the available hose and nozzle to the entrance of the main shaft and simultaneously opened both this and the vertical shaft, converting the former into a down-cast and the latter into a roaring furnace. The fire, however, continued to advance up the main shaft, producing a thunderous fall at No. 1 level north, which gave some check and protection, but the fire crept up the timbers left standing and we could just reach it with the nozzles, and after several hours of anxious work, had the satisfaction of stopping it. This was better than letting it pass the 'fall' and trust to the hydrant. Although the main shaft was down-cast there was still an upward current of smoke overhead both above and below the roof timbers, so we were cramped for room to work. The large mass of timber debris at the foot of the vertical shaft burnt itself out.

The chaos in the main shaft where the fire had passed can be better imagined than described. The top 200 ft. was saved and though afterward in great part re-timbered, it never 'came in,' which was the main point; otherwise the surface works and machinery near the mouth of the shaft must have suffered. It was subsequently found that the fire originated in an old bin at the 4th level, but how it originated was and always will be a mystery.



The actual quenching of the fire was not achieved until November 23, the delay in the last half of the time being due, of course, to the frequent cessation of operations to prevent too much rekindling. It was necessary to purify the lower levels and connecting workings, lest the foul gases and smoke should entrap any of the workers, and though there were many instances of partial and some of total insensibility, it was a satisfaction to come through without loss of life.



PERSONAL

R. M. ATWATER is in London; he sails for New York on August 20.

L. S. AUSTIN, RALPH NICHOLS, and J. B. RISQUE, have formed a partnership with headquarters at Salt Lake City.

A. C. BEATTY has returned to New York, but expects to be in London again in a couple of months.

JUAN F. BRANDES has left Paris to go to Chihuahua, Mexico.

GELASIO CAETANI is at Tombstone, Arizona.

W. A. CARLYLE went to Montreal in July, and is now on his way to the Balkans.

RICHARD E. CARR, of Cordova, is at Harrogate taking the waters.

H. N. G. COBBE in designing the metallurgical plant at the Cam & Motor mine, Rhodesia.

J. J. COLLINS sailed on July 20 for Nigeria, where he will be in the employ of the Tinfields of Northern Nigeria, Ltd.

W. COOPER has received an appointment with the Memba Minerals Ltd., in Portuguese East Africa.

J. H. CURLE was in Finland recently.

THOMAS A. DOWN sailed on August 5 for Minas Geraes, Brazil.

ROWLAND C. FEILDING is in Newfoundland.

A. M. FINLAYSON has received an appointment as petroleum geologist to Steel Bros., in Burma.

FRANK GRIFFIN sailed on the Baltic on July 23, after a trip in Italy and Egypt.

A. GROTHE, the president of the Mexican Mining Institute, was in London during July.

EDWARD HALSE is in Spain.

H. W. HARDINGE left New York on July 16 to go to Sweden.

C. S. HERZIG was in California during July.

LIONEL E. HILL has gone to Rossland, in the employ of Alexander Hill & Stewart.

H. C. HOOVER was in Saxony recently.

J. POWER HUTCHINS is at Stretensk, in Siberia.

H. A. JUDD has gone to Northern Nigeria for Lake and Currie.

COURTENAY DE KALB has resigned the associate editorship of the *Mining and Scientific Press*, to become general manager for the Pacific Smelting & Mining Co. at Fundicion, in Sonora, Mexico.

W. J. LORING is still in Australia and is not expected in London until October.

MALCOLM MACLAREN expects to return to London from Kalgoorlie in October.

H. K. MASTERS sailed for New York on July 15, expecting to visit Kentucky.

R. E. PALMER, of Rio Tinto, is taking a holiday, which includes a voyage across the Atlantic and to the copper regions of Arizona.

ARTHUR L. PEARSE sailed on July 27 for New York.

LAURENCE PITBLADO is inspecting dredging ground in the Altai district, Siberia.

THOMAS T. READ was married at Peitaiho, in China, on July 26.

RICHARD ROSEWARNE has been appointed surveyor and engineer to the Atbasar Copper Fields.

STANLEY C. SEARS has been appointed technical manager for the Mexico Consolidated Mining & Smelting Co., at Parral.

HAROLD SHARPLEY sailed for New Zealand on August 5, to take charge of the Blackwater mine.

HOWARD D. SMITH left London on July 20, returning to San Francisco by way of New York.

C. H. STEWART, of Alex. Hill & Stewart, has returned from the Caucasus.

A. J. G. SWINNEY left on August 4 for the Dutch East Indies.

H. W. TURNER has been examining oilfields in Alaska.

R. A. VARDEN, late of Bainbridge, Seymour & Co., left England in July for Western Australia to succeed Ernest Williams as local partner of Hooper, Speak, & Feilding.

H. H. WEBB has returned from South Africa and will be going to the United States.

ERNEST WILLIAMS has resigned as representative of Hooper, Speak, & Feilding at Kalgoorlie, and is returning to England.

A. STANLEY WILLIAMS is in Nigeria.

W. H. WILEY was in London during July.

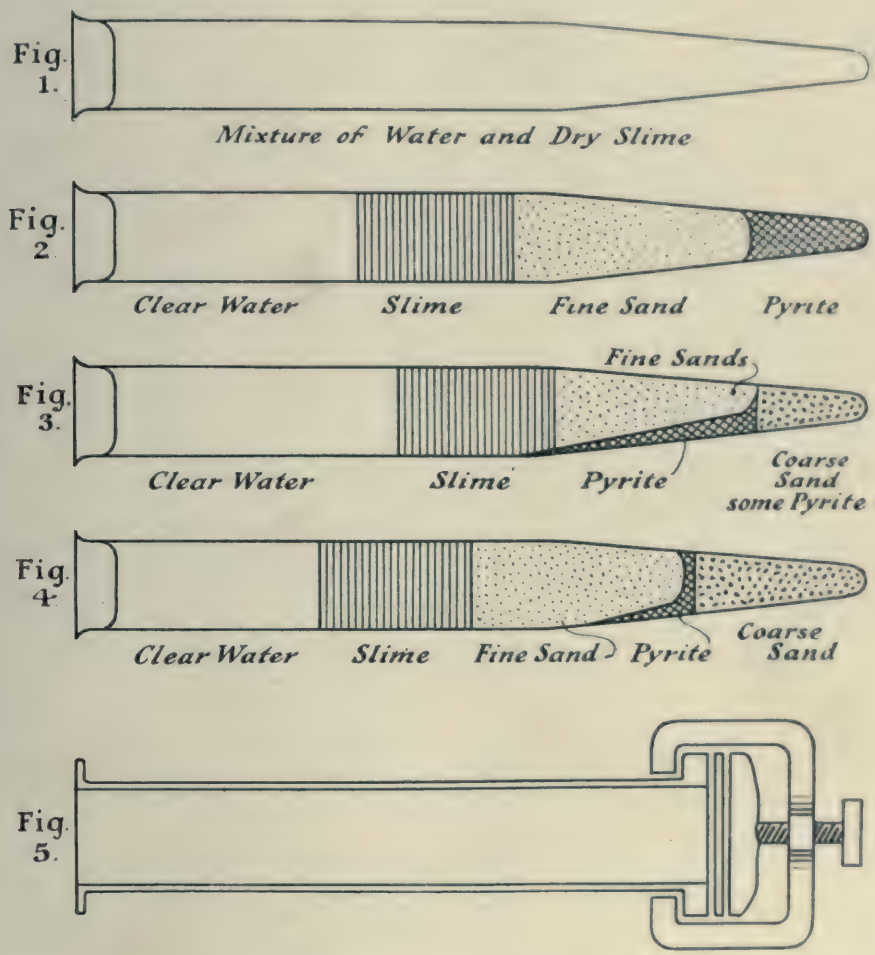
G. D. NEVILE WYATT has left England to assume the post of chief chemist at the Kyshtim mines, in the Ural.

ALLEN M. YONGE is now associated with J. R. Farrell and R. C. Shaw.

METHOD FOR TESTING SLIME

By GEORGE J. YOUNG

THE vanning plaque or shovel is ordinarily used to make a test upon the tailing from vanners. Where the tailing consists principally of sand, the test can be made rapidly and satisfactorily; but with slime more care and time are required. For this purpose I have found it convenient to use the small laboratory 'centrifuge' in place of the plaque, and the results are sufficiently satisfactory to warrant my bringing the method before your readers. The 'centrifuge' consists of two cups, fastened to the extremities of a horizontal bar. The bar is fastened at its centre to a vertical shaft. The slime to be tested is mixed with water and placed in two tubes, resembling test-tubes; these are placed in the cups, and the vertical shaft is rotated at from 2000 to 3000 r.p.m. for several minutes. The result is to force all the concentrate and any coarse sand to the end of the tube, where they may be readily seen and examined.



By using a graduated tube and calibrating the same with known weights of pyrite (or other heavy minerals), approximate quantitative results may be obtained. The presence of much fine sand or of any coarse sand renders the results unsatisfactory. The distribution of the materials in the tubes is illustrated by the accompanying sketches.

Fig. 1 shows the uniform mixture of slime and water; Fig. 2 the result obtained when coarse sand is absent; Figs. 3 and 4 show two results when coarse sand is present.

One necessary condition for successful separation is that the slime and water must be thoroughly agitated up to the instant the tubes are placed in the cups and then the centrifuge started without delay. The separation between slime and fine sand is often sharp and the fine sand is well classified, the finest being next the layer of slime, the coarsest toward the end of the tube. I have used a ratio 3 or 4 of water to 1 of slime; with large ratios of water it is preferable to settle with lime and then use the settled slime in the test.

The tubes shown do not admit of the removal of the separated slime, fine sand, and concentrate. Where it is desirable to do this, I would suggest the design of tube shown in Fig. 5 as answering the purpose. Centrifuges of several patterns and sizes are on the market and are sold usually by the dealers in assay supplies.

Costs of Mining in Cornwall.—In our issue of October last we quoted an article by Harold E. Fern, contributed to the *Records* of the London and West Country Chamber of Mines, giving a comparative analysis of the working costs during 1908 at the nine chief mines in Cornwall. Mr. Fern has now supplemented this study by presenting a similar table for 1909. The items tabulated include salaries, wages, directors' fees, cost of materials, electric power, carriage and freight, repairs and renewals, allowance for depreciation, rent and rates, income tax, royalties, insurance, office rent and travelling expenses, general and office expenses. The 'materials' specified are coal, timber, explosives, castings, stores, and sundries. The various mines do not give full details under all these subdivisions of 'materials,' but the information is always sufficient to make comparison possible. On this basis of calculation the cost per ton of ore treated during 1909 at Dolcoath was 29s. 10d., at Basset 29s. 11d., Carnbrea & Tincroft 22s. 6d., South Crofty 21s. 2d., Grenville 24s. 9d., Wheal Kitty 27s. 2d., East Pool 21s. 6d., Levant 33s. 9d., and West Kitty 22s. 8d. These figures do not show much alteration compared with 1908, with the exception of West Kitty, where the expenses have fallen considerably; as however this mine is in a state of semi-suspension the figures are really no guide. The variation in cost at different mines is considerable, but can generally be explained by some particular circumstance. For instance the cost at Basset is high on account of the great expense of pumping and also because much development work has been done. The depth of the workings at Dolcoath may account for the high cost, for all the items are above the general average of the district. South Crofty costs are low because mining methods are studied closely from the modern standpoint. At East Pool they are low because development has been utterly neglected recently. On the other hand the costs at Wheal Kitty are high because a great deal of development is being done; it is a small mine and one foot of development is done for every 4 tons of ore stamped, compared with ratios of 1 : 17 at Dolcoath, and 1 : 12 at South Crofty.

We would take this opportunity of saying that the figures published by Cornish mines are of little value because they do not segregate the costs into the separate departments of the work. To give the totals of wages, salaries, and coal does not help at all in estimating the cost of operations. What we really want is that these items shall be split and the various departments of expenditure debited with their corresponding proportion of the cost. In this way we should be enabled to ascertain the cost of the various operations and so obtain a more intelligible idea of the conditions prevailing.

Gold Extraction.—In United States patents numbered 955318–9, J. C. Clancy, of New York, describes a cyanide process which is applicable to ores that are usually roasted. In addition to the cyanide he uses in the solution potassium iodide and an oxidizing agent, such as persulphate of soda. As the function of the iodine is that of a carrier, the potassium iodide is continually regenerated, so little of it is lost. A typical solution contains in 1 ton of water, 1 lb. cyanide, ½ lb. iodide, 3 lb. persulphate, and ½ lb. of soda or lime.

Corrosion of Metals.—The Institute of Metals has appointed a committee to investigate the causes of the corrosion of non-ferrous metals by sea-water, acids, and other solutions, set up by chemical and electrolytic actions. This is a large subject and the attention of the committee will be centred at first on the corrosion of condenser tubes, exposed to the action of sea-water or to foul water on land, or subject to electrolytic action, as often is the case in electric power stations. Before commencing research work, the information already available is to be collected by G. D. Bengough, of Liverpool University.

COMPANY REPORTS

Buffalo.—This mine is situated in the centre of the Cobalt silver district, Ontario, Canada, and has been paying dividends since 1906. It is not among the largest producers, but has been a pioneer in extraction, having adopted the cyanide process for the treatment of tailing and slime. T. R. Jones is engineer. The report for the year ended April 30 shows that 39,679 tons of ore was mined, of which 7527 tons was broken in development and 32,152 tons came from the stopes. Of this 27,868 tons was raised, and in addition 5840 tons on the surface awaiting treatment was sent to the mill, making the total ore treated 33,708 tons. The saving in the mill was divided almost equally between the jigs and tables. The shipments to the smelters consisted of 115 tons of high grade ore averaging 3126 oz. per ton, and 654 tons of concentrate averaging 1570 oz. the total yielding 1,386,323 oz. The cyanide plant started work in August 1909, and treated 6424 tons of slime; the yield was 54,872 oz. and the extraction 66%. The cyanide bullion shipped to the smelter yielded 54,479 oz., making the total output for the year 1,440,802 oz. The net receipts from the smelters were $731,473. The costs were: mining $127,931, milling $58,443, cyaniding $28,094, repairs, etc., $44,749, depreciation $31,962, administration $34,292. There were other small items to include, and the net profit was $402,013 out of which $320,000 was distributed as dividend, being at the rate of 32%. The cash balance in hand was $267,003. The profit for the past year was nearly double that for the previous year, and the output of silver 50% higher. On April 30 the reserve was estimated at 74,000 tons averaging 60 oz. The capacity of the mill has been increased from 90 to 130 tons per day, and will be still further increased in the near future to 160 tons. Operations have been retarded by the delay in obtaining compressed-air power and electric current from the supply companies, and development work has been restricted in consequence. The current was obtained towards the end of the year, and the compressed-air power supply was ready on June 1. It will now be possible to go ahead with shaft-sinking and systematic development. The company owns 40 acres of which only 11 acres have been prospected so far.

Tennessee Copper.—This company belongs to the Lewisohn group, and owns mines near Ducktown, Tennessee. J. Parke Channing is one of the directors, N. H. Emmons is manager, and H. F. Wierum consulting engineer. Production commenced in 1901 and dividends were first paid in 1903. The ore averages less than 2% of copper and the extraction has varied from 1·5% to 1·88%. The sulphur content is high and during recent years the waste gases have been used for the manufacture of sulphuric acid. The output of copper rose from about 8 million pounds in 1902 to 14½ million pounds in 1908. The report for the year 1909 shows that 441,906 tons was mined, and 439,365 tons smelted, yielding 14,058,954 lb. In addition, the furnaces treated custom ore yielding 2,415,734 lb. and purchased ore that yielded 101,995 lb. The cost of production was 9·15 cents per lb. and the total cost including freight, commission, administration and general expenses, 10·68 cents. The total operating cost per ton of ore during 1909 was $3·41. These are figures that have not varied greatly from year to year. The profit in the copper department was $296,017 and on sulphuric acid manufacture $82,831. The total profit for the year was $339,405, out of which $75,000 was placed to reserve and $250,000 paid as dividend at the rate of 5%. The total dividends to date have been $2,306,250 on a capital of five million dollars. The company owns four mines of which the production during the year was: Polk County 93,208 tons, Burra Burra 264,939 tons, London 81,952 tons, and Eureka 1807 tons. At the first-named, the 385 ft. level has been developed during the year; diamond-drilling has shown that the orebody persists in depth and arrangements are accordingly being made to open up another level at 485 ft. At the Burra Burra the main shaft has been sunk to the 7th level. The Eureka is being developed by open-cut and the ore is found to be of great value in acid-making. The company's reserve has been increased during the year by 200,000 tons of 'developed' ore and 660,000 tons of 'profitable' ore. The

THE BUFFALO MINE, AT COBALT, ONTARIO.

total figures are 3 million tons 'developed,' of which 2½ millions is in the Burra Burra, and over 1 million 'probable,' of which most is at the Eureka. During the year the method of mining has been altered to a modified back-stoping, which is both safer and cheaper. At the smelter, operations were slackened during the spring and summer, while the crops were growing, so as not to give any cause of complaint to the farmers. A sintering plant has been added for the purpose of making use of flue-dust, which has hitherto been considered of no value. In order to obtain a more regular furnace-charge an elaborate bedding plant has been provided. The total extraction of copper has been increased by these means and is now 81%, with a prospect of a further increase. The existing sulphuric acid plant has been re-modelled at considerable cost and a second and larger unit is under construction. By means of this acid plant and the consequent saving of the sulphur content, the value of the ore reserve is practically doubled. In order to meet the expense of construction, three-year loans for $600,000 have been raised. The manager has had difficulty in keeping a full force of men at work especially underground, and efforts are being made to attract a population by providing comforts in the way of club-houses, athletic fields, etc. Another interesting new departure is the acquisition of a tract of farm-land; by this means the company's officials will be able to tell by practical experience what actual effect the gases from the smelters and acid-plant will have on agriculture.

Mond Nickel.—This company was formed ten years ago to acquire nickel-copper mines at Sudbury, Ontario, and to refine the matte at Clydach, Swansea, by the late Ludwig Mond's process, according to which the nickel is removed as a volatile carbonyl compound while the copper is subsequently obtained as sulphate. At first the refining process gave much trouble; it is intricate as well as dangerous. During the first three years the inventor, who had originally taken his purchase consideration in ordinary and deferred shares, decided to pay the dividends on the preferred shares out of his own pocket, as the process had taken much longer to perfect than he had contemplated. The issued capital of the company is £400,000 in preferred shares carrying a cumulative dividend of 7%, £300,000 in ordinary shares, and £50,000 in deferred shares. During the year ended April 30, 1904, the company earned sufficient profit to pay the preference dividend; the year after saw a dividend of 6% on the ordinary shares; and for the year 1905–6 the deferred shares received 18%. The ordinary dividend was 10% in 1905–6, 12½% in 1906-7, and 15% regularly since. The dividend on the deferred shares rose to 33% in 1906–7 and has been 48% since. The report for the year ended April 30 shows a net profit of £114,106, which is almost identical with that of the two previous years. The company does not give any figures relating to the production of copper sulphate or nickel, but states that operations have been extended, thus making it possible to maintain profits in spite of the low price of copper. The consumption of nickel is increasing, especially for use in making nickel steel for bridge building and other structural work. The report also records that the hydro-electric plant on the Vermilion River is completed and is supplying power to the mine and smelter. This plant is owned and operated by a subsidiary local company in order to comply with the Canadian charter. Some current is sold to outside customers and additional profits will accrue therefrom to the nickel company. The directors refer with regret to the decease of Ludwig Mond, by whose unremitting application the company was brought to a success. We should like here also to record the valuable services given to the company and to Dr. Mond by Carl Langer, the metallugical engineer at Clydach.

Waihi Grand Junction.—This company was formed in 1895 to acquire property to the west of the Waihi gold mine, in New Zealand. Three of the Waihi lodes are found in the Grand Junction mine, namely the Martha, Royal, and Empire. For many years prospecting and development work gave disappointing results and large amounts of capital have been expended. Milling eventually commenced in 1906 with 40 stamps bought from the Kauri company, and 4 tube-mills with cyanide plant were added. More recently 60 new and heavier stamps and 6 tube-mills were purchased but have not yet been erected. F. C. Brown, known in connection with agitator-vats and tube-mill lining, was until the end of 1909 the general manager, when he was succeeded by W. F. Grace, who had shortly before been sent out to examine on behalf of people who had provided further funds for working capital. The report for 1909 was published last month, but by far the most interesting and important information relates to the period since the close of the year, for the underground developments conducted under Mr. Grace's directions have been both energetic and successful. At the meeting of shareholders the recent discoveries were given in detail, from which it would appear that the Royal lode promises to become the important producer. The Empire lode is developing in a satisfactory way, and a new lode christened the George has been found. The yield has been continually improving and the costs decreasing so that the results during the first five months of this year show a decided change as against a year ago. In regard to the results for 1909, it is reported that the general conditions improved greatly during the year, so that a profit was made in spite of the gloomy results published in the half-yearly report issued during the summer. The mill treated 59,147 short tons yielding bullion worth £100,687, or 39s. 5d. per ton. Mining cost £37,045, extraction £24,489, development redemption £11,829, administration in New Zealand £6306, in London £3256, depreciation £7279, gold duty and realization expenses £4220; there were other small items, and the balance of profit was £5729. This result is encouraging, after so many years of expenditure and debits. For the first five months of 1909 the ore treated was 28,952 tons and the yield was worth £44,822. Mr. Grace does not propose at present to erect the 60 new stamps but has added two of the tube-mills to the existing plant and finds that the installation can now treat 400 tons per day. He has also improved the extraction by inaugurating a system for keeping the circulating cyanide solutions clean. It should be mentioned that no mercury is used in the stamps and the ore is 'all-slimed'; recently the extraction fell away and Mr. Grace examined the cyanide circuit and detected the weak point. By means of the improvements introduced the extraction is improved and the consumption of cyanide decreased. During the past year the capital was increased by the issue of 70,000 new shares which were taken by shareholders at par, with rights to subscribe to 35,000 other shares at 30s. each; by this means the debt of £60,000 raised by loan has been discharged and an ample supply of working capital provided.

Tampico Oil.—This company has been formed with a capital of £70,000 to acquire and develop oil lands in Mexico, on the banks of the river Panuco, 19 miles from Tampico. The properties adjoin those belonging to the Ebano company and the chief is the Salinas. The engineer is H. F. Drader.

Oroville Dredging.—The English company, Oroville Dredging Company Limited, was formed in June 1909 and acquired the shares of the Oroville Dredging Limited, the American company controlling the operations of four local companies in California since 1905. The formation of an English company was undertaken for two reasons, one being that the shares of the American company were largely held in England, and the second that additional properties were to be acquired at Pato in Colombia and the additional funds therefor raised in England. The directors of the English company distributed last month the report of the American company for the year ended July 31, 1910, together with a statement relating to the general position of affairs. As regards the delay in publishing reports, this is an old reproach against the American company and it was hoped that the formation of the English company would remove it; but the change has not been effective so far. The statement of the directors shows that the transfer of the Colombian property has not yet been made. The intention was to pay for it chiefly by the issue of £85,000 debentures by the English company, bearing 8% interest, and gradually to extinguish them out of profits. The American owners of the mines were not agreeable to this proposition, not feeling confident of the security, so the directors since December have been using the profits in California for the purpose of paying instalments on the property and for building an 8½ cu. ft. dredge. Thus £35,000 has been paid. They are considering the advisability of completing the purchase in this way and of suspending dividends until early in 1911. Some funds have also been provided by the sale of three of the older dredges at Oroville, $92,000 being realized. Plans had been made for building two more dredges at Oroville of modern design with 14-ft. buckets. These are expected to treat the gravel at a cost of 3 cents per cubic yard. Owing, however, to the financial requirements in connection with the Pato property, the construction of these dredges has been postponed.

The report of the American company for the year ended July 31, 1909, shows that at the four different series of operations 6,398,632 cu. yd. was excavated over 125 acres, the average depth being 31 ft. The individual items were 1,729,600 cu. yd. at the Boston & California, 1,257,735 at the Boston & Oroville, 2,649,918 at the Oroville Exploration, and 761,370 at the Bear River. The total expenses were $372,414 and the returns of refined bullion $725,635, making a net revenue of $353,221. The Boston machine-shop made a profit of $10,814, and there were a few other miscellaneous receipts. Royalties of $31,429 were paid by the Boston & California, and the net profit in California was $334,664. The distribution of dividends during the year was $348,440, or at the rate of 10%. The report gives a close analysis of the whole of the operations. From this we find that the returns at the four centres in the order quoted above were 19·03, 8·43, 9·31, and 5·76 cents respectively and the costs 6·06, 6·75, 4·98, and 6·64 cents per cubic yard. The net revenues were 12·97, 1·67, and 4·33 for the first three and a debit of 0·88 cents for the Bear River. The average cost at the four places were labour and material 1·5 cents, electric power 0·78, water 0·1, repairs 2·69, general 0·47, taxes and insurance 0·28 cents, per cubic yard, from which it will be seen that 'repairs' is a large item. The year commenced with 9 dredges; one dredge, an old 3-ft. notable for high renewal cost, was sold for $20,000; the other two reported above as sold were disposed of since the end of the year. The results at Bear River were better than during the previous year, but the large size of the boulders still continues to cause trouble. W. P. Hammon in his report gives details of the working of each dredge; his figures and the report generally would be of greater service to the technology of dredging if they

DREDGING ON THE FEATHER RIVER, CALIFORNIA.

were published while the news was fresh. Progress is so rapid in this class of mining that news soon becomes stale.

Great Fitzroy.— This company was registered in Australia in July 1908, with head office at Melbourne, to acquire a copper mine at Mount Chalmers, in Queensland. Bewick, Moreing & Co. are the managers and until recently D. E. Bigelow was superintendent. We gave particulars based on the report for the year ended June 30, 1909, in our issue of October. Last month a cable was received from W. J. Loring stating that the wet concentration plant was a failure owing to the loss in fine material. In addition, the smelting was unsatisfactory as so much of the ore escaped into the flues. Accordingly he has closed the concentrating mill and ordered a flotation plant from the Minerals Separation company capable of treating 200 tons per day, besides sintering furnaces. By these means it is expected to obtain a much higher concentration, 85% being the estimated recovery; while by sintering the fine concentrate the losses in smelting will be greatly reduced. The total extraction is estimated to be eventually 76% of the contents. On the closing of the concentrator, one of the furnaces was stopped and the other fed with raw ore, and it is expected that a profit will be made in this way while waiting for the new plant, which should be ready by the end of the year. From July 1 to 10, the amount of crude ore treated was 1880 tons; from which was recovered matte containing 56½ tons copper, 333 oz. gold, and 1437 oz. silver. Mr. Loring also reports on the ore reserve. He estimates that 562,913 tons of siliceous ore averaging 3·08% copper and 2·62 dwt. gold and 91,920 tons of pyritic ore averaging 2·38% copper and 2¼ dwt. gold are ready for stoping above the 300 ft. level, and that profitable ore is found over large areas on the floors of the drifts and cross-cuts on this level. The orebody appears to be flattening below this level. The figures for the ore reserve are not as high as those prepared in December last, as dikes and horses have broken the continuity of the ore, and it has consequently been necessary to allow for these barren parts.

Burma Ruby.—This company was formed 22 years ago by the Rothschilds to consolidate the ruby and sapphire workings at Mogok, in Burma. We gave particulars of its history in an earlier issue. The report for the year ended February 28 shows that the company is still suffering severely from the slump in the demand for valuable stones of the corundum group. The difficulty is to determine the cause of the present slackness. Originally it was attributed to the general depression and to the financial stringency throughout the world, especially in America, for the slump commenced at the same time as that in diamonds. Now, though the market for the latter has recovered, the coloured gems are still under a cloud. It is practically impossible to trace the ultimate destination of the Burma stones. About a quarter of the output goes to England for disposal and three quarters are sold locally; how many of these are absorbed in India and Eastern countries it is not easy to determine. Genuine rubies and sapphires are not now fashionable; thus the demand for high-class stones is at a low ebb. As regards the spinel group, these have been largely replaced by the variety of garnet known in the trade as the Cape ruby, which in its way is a sufficiently beautiful stone. Complaint is made by the directors of the competition of 'spurious' stones; these are the garnets and not the artificial imitations. Shareholders have an idea that 'reconstructed' rubies have damaged the sale of the large and high-priced rubies; however, the number of such stones that ever make their way into the market is inconsiderable. The directors report that during the past year they have made reductions in price and have thus effected increased sales; they hope by this extension of business to raise the prices again later on. During the year 1,594,993 loads were washed at a cost of 6·2d. per load, as compared with 1,071,166 loads the year before at 7·9d. per load. The sale of stones realized £13,356 in London and £42,087 in Burma. Mining expenses were £41,185, allowance for depreciation of machinery £5185, administration £8200. The balance of profit was £1015, which was carried forward. No allowances is made for the rent and commission on production payable to the Indian government. This item has been accumulating for three years and now stands at £23,942. Negotiations are in hand with the Government with a view to obtaining some remission. The Government has already agreed to forego the rent charge in future and to be satisfied with royalties payable when the sales are actually made. The question of remitting the accumulated debt is still under consideration; this is an important question, for if the money has to be paid, the company will be without the funds required for developing additional ground. If such development work is not done, the operations of the company will come to an untimely end and many natives will be thrown out of employment. It is therefore obvious that there is a struggle between the Government and the company with regard to the policy of keeping the mines going.

Broken Hill South Blocks.—This is one of the most recently developed properties on the Barrier Range. It was acquired from a local company in 1905 by the Lake View Consols; F. A. Govett is chairman and Bewick, Moreing & Co. are managers. The pioneer work of development and concentration was done by J. A. Diggles whose decease after a long illness was recorded recently with regret. He has been succeeded by O. B. Ward, who was previously with the Lake View Consols. When the English company was formed £50,000 working capital was subscribed by the Lake View Consols, which took 100,000 shares; another 100,000 shares were given to shareholders in the Australian company in exchange for their holdings. The concentration operations so far have been confined to the production of a high-grade lead-silver concentrate. The mine also contains a second lode higher in zinc, but this is not being actively developed at present. The report for the year ended March 31 shows that 117,172 tons of ore was sent to the mill. This averaged 16¼% lead, 10% zinc, and 2½ oz. silver. The yield was 23,072 tons of concentrate averaging 66% lead, 7% zinc, and 9 oz. silver, and the percentage of extraction was 80% of the lead and 71% of the silver. With the beginning of the period under review the concentration plant was altered so as to produce a zinc tailing separate from the quartz tailing. Of this 17,523 tons was produced averaging 21% zinc, 4% lead, and 1·4 oz. silver, and has been stored for future treatment. No steps are being taken at present to erect a treatment plant for this product, and the question will probably be postponed until such time as the zinc lode is actively exploited. Developments at the mine have continued to expose large bodies of ore and the reserve on March 31 was estimated at 536,458 tons assaying 15·9% lead, 10% zinc, and 3 oz. silver. This figure is 117,152 tons higher than a year ago. The income from the sale of concentrate was £119,721. The cost of mining was £45,324, development £16,822, concentration £35,692, general expenses at the mine £4896, London expenses, taxes, etc. £4900, and new plant £1950. The balance of profit for the year was £10,000, which has been carried forward. The average price

of the metals during the year was £12. 19s. 3d. for the lead and 25§d. for the silver. The concentrate is sold to the Broken Hill Proprietary. As the smelting plant at the latter company's works was closed during the first half of 1909 owing to labour troubles the year's production of the South Blocks was not regularly delivered, but later on the whole of the accumulated material was shipped and treated. The contract for the sale of concentrate has been extended to the end of 1912 at a small increase in the returning charge. The South Blocks has suffered during the year from the high price of fuel, but as the supply was never exhausted the operations did not come to a standstill at any time. At first high prices had to be paid in order to secure local coal, but later the deficiency was made good by supplies from England, India, and Natal. The delay in shipping the concentrate and the high price of fuel combined to bring the working cost to a higher level by 10d. per ton than during the previous year. The policy of paying famine prices for coal was justified by the continuity of operations, making it possible to keep the efficient staff together. As regards the future the directors consider that the amount of money spent out of revenue for development purposes should be curtailed for a couple or more years in order that shareholders shall have a dividend, a luxury they have not yet enjoyed. The reserve is sufficient for the requirements of the mill for five years. It is felt that a large expenditure on development is under these circumstances a mistaken policy while the prices of metals are low. During the next four years there is some chance of a rise, and as the profits would then be greatly increased the expenditure of larger sums for development would not then affect dividends so seriously. About £70,000 has already been provided out of revenue for capital and development expenditure, so that the general position of finances cannot be regarded as otherwise than sound, and the directors' proposal seems reasonable. After a short time, when the main shaft has been sunk to the required depth for efficient mining of the present reserves, further operations will be suspended; also the south shaft will not be continued and the development of the zinc lode will consequently be postponed. This curtailment of expenditure will permit the payment of a dividend toward the end of the present year. The zinc lode is situated 150 ft. west of the main lode and contains ore averaging 17 to 20% zinc, 8 to 9% lead, and 1 to 2 oz. silver. A similar deposit has been found in the South Extended property; it appears to be the same lode, if so, the South Blocks will contain 2000 ft. of additional ore-bearing ground.

Amalgamated Zinc (De Bavay's).—This company was formed in Melbourne last autumn to acquire the flotation plant and tailing heaps at Broken Hill belonging to the De Bavay Treatment Co., and to extend operations by building a new mill embodying recent improvements. Details contained in the prospectuses were quoted in our issue of November last. The report now published covers the period from registration until April 2. During this time production was confined to the old mill. On March 21 the first unit of the new mill was completed and after running experimentally for ten days was put in full commission on April 2. During the six months from the beginning of October to April 2, the old mill treated 54,038 tons, producing 15,767 tons of zinc concentrate assaying 48·6% zinc, 6% lead, and 6 oz. silver, besides 220 tons of lead concentrate assaying 53% lead, 14% zinc, and 24 oz. silver. The receipts from sales were £45,654; treatment and zinc tailing cost £27,861; administration in Australia and London £3744. The whole preliminary expense, £3378, has been written off; the balance of profit, subject to final adjustment of prices according to the selling contract, was £11,721. During the eight weeks from April 3 to May 28, the old mill

PLAN OF THE BROKEN HILL MINES, NEW SOUTH WALES.

and the first unit of the new treated 47,658 tons producing 13,814 tons of zinc concentrate and 179 tons of lead concentrate. The new mill gives even better results than were expected, for a weekly capacity of 4200 tons has been attained on tailing from the Broken Hill South Silver mine. The second unit was completed by the end of June and the third is under construction. The total expenditure involved in the new mill is £150,000, which is greater than the estimate owing to more plant being required for final separation of lead from the concentrate, and also because of the higher costs of labour due to scarcity. The directors speak appreciatively of the services of the manager, H. W. Gepp.

Victoria Falls & Transvaal Power.—This company was formed in 1906 under the auspices of the British South Africa Co. to establish power-supply stations in the Transvaal and Rhodesia. The primary object was to utilize the Victoria falls on the Zambesi river, and secondarily to establish steam-power installations on the Rand. For various reasons the first part of the programme has been postponed and operations were centred on the latter. The steam-plant of the General Electric Power Co. at Driehoek was acquired and also that of the Rand Central Electric Works, at Brakpan, in the East Rand. The latter has been greatly enlarged. Subsequently another plant was erected at Simmer Pan, and plans have been completed for a third at Rosherville. The Brakpan plant was put into commission in the early part of 1909 and the first part of the Simmer Pan plant in the following July. The report of the company for 1909 together with information given at the meeting of shareholders last month shows that the Simmer Pan plant has been extended and the capacity is now 27,400 h.p.; also the Brakpan plant has been increased by 9700 h.p. The Rosherville plant will consist of five steam-turbine sets of 9600 kilowatts each, and four air-compressors of 4000 h.p. each driven by steam-turbines; part will be ready at the end of 1910 and the rest at midsummer 1911. The business of the company is extending so substantially that another installation is under consideration. For this purpose an agreement has been made with the Vereeniging Estates and Lewis & Marks for the erection of a 53,600 h.p. installation on the Vaal river, the contract calling for the purchase of coal from the companies named. The prosperity of the company has also made it impossible as yet to discard the old Driehoek plant, which is not up-to-date or economical. The total capacity of the plant will eventually be 155,100 h.p. for electric current, and 16,000 h.p. for air-compression. The amount of current supplied will be 500 million units per annum. The distribution lines will extend from the West Rand Consolidated to the Cloverfield, a distance of 45 miles. The directors report in flattering terms of the prompt delivery of plant by the Allgemeine Elektricitats Gesellschaft of Berlin, the company that secured the contract. It is notable also that much of the capital has been supplied in Germany, the issue of £900,000 of debentures a few months ago having been taken by the Deutsche and Dresdner Banks. The capital has been continually increased as required for the building of the plant and now stands at £1,000,000 in ordinary shares, £1,838,000 in 6% cumulative preference, and £1,700,000 5% debentures. No profit and loss account has as yet been submitted, seeing that the company is still occupied chiefly with construction, and the profits of existing plant are carried to the balance sheet. The first instalment of preference dividend will probably be paid in May next. The Chairman, the Marquis of Winchester, in his speech to the shareholders mentioned that the saving both in capital outlay and of power to the companies using their current was remarkable. At the City Deep, for instance, the saving in outlay was £124,000, and generally the saving in power bills is from 6d. to 1s. per ton crushed. The report refers to the negotiations between the company and the Government with regard to the framing of the law regulating large power supplies and expresses agreement with the law as passed. During the year Bernard Price, an engineer of experience in the application of electric power to collieries in the North of England, has been appointed engineer in chief to the company in South Africa.

Troitzk Goldfields. — This company is one of the subsidiaries floated in 1906 by the Siberian Proprietary. It was formed to acquire from Heyman Orkin certain gold mines near Kotchkar, Orenburg, that had been worked for some years by a local company. It was soon found that the ore was of low grade and it became necessary to make an independent examination. Hooper & Speak were commissioned to report and to make suggestions for the future working of the property, and Edward Hooper was elected to the board. They recommended thorough exploration and development, and the building of a new mill better suited to the ore than the old plant. Last year H. C. Bayldon was appointed general manager, and Hooper, Speak, & Feilding continue to be the consulting engineers. The report for the year ended January 13 (December 31, 1909, Russian style) shows that the mine has now reached a profitable stage, though, owing to the interest to be paid on the loan from the Siberian Proprietary, depreciation, and London expenses, the balance of profit and loss is still against the shareholders. The new mill was started at the end of August, and operations at the old mill were then discontinued. The ore fed to the new mill was of lower than the average grade in order that during the first few months, until the mill was in thorough working order, the better class of ore should not be wasted. At first trouble was experienced in amalgamation and also in the cyanide circuit, but these initial troubles are now over. The production and extraction during the period covered by the report is not a fair reflex of actual conditions at the present time, for the reasons enumerated. From January to August the old mill treated 18,174 tons for a yield of 4580 oz., the ratio of extraction being 83·2%. For the rest of the year the new mill treated 13,865 tons and produced 2756 oz., being a recovery of 71%. The ore reserve at the end of the year was 37,430 tons averaging $8\frac{5}{8}$ dwt. per oz., as compared with 5900 tons averaging $5\frac{3}{4}$ dwt. a year before. These figures include only the actually proved ore in the main lode; other 'probable' and 'possible' ore is in place in the main lode and there are also uncalculated reserves in the Pokrówsky lode. During the year 4716 ft. of development work was done, and the deepest workings are on the 580 ft. level. The main shaft will be sunk to 780 ft. and a level opened at 680 ft. during the current year. The geological and physical conditions at the 580 ft. level are favourable to the persistence of the deposit in depth. The expenses of mining were £17,946, milling £10,282, development redemption £2183, depreciation £2328, interest on loan £2066, London expenses £3637. The balance of loss was £6261, which added to the debit balance for the previous year brings the total on the wrong side to £32,347. Having a modern mill suitable for the ore, and capable of treating 6000 tons per month, the problem before the engineers is now to prosecute development in order to provide a regular supply. The outlook generally is hopeful. In the new mill Chilean

mills are used ; following amalgamation, the pyrite is removed on Wilfleys, and the remainder cyanided. The concentrate is roasted and cyanided.

Orsk Goldfields.—This company was formed by the Siberian Proprietary in 1905 to acquire from Heyman Orkin certain mines in the Orsk district of Orenburg. These proved to be valueless and subsequently the controlling interest in a gold-gravel property was acquired through the agency of the Russian Mining Corporation. The name of the property is the Kolchan ; behalf of creditors, the Russo-Chinese bank. Mr. Purington visited the mine in 1907, and again in 1908 and 1909. On his first visit he sunk 116 pits, from 10 to 25 ft deep, distributed over an area of 200 acres and proved the presence of gold worth £285,000, which he subsequently estimated could be recovered in 7 years with one modern dredge at a total capital expenditure of £50,000. A further tract of country ten times this area remains to be systematically sampled, and surface examinations give reason for believing that it will

MAP OF SOUTHWESTERN SIBERIA. SCALE ABOUT 250 MILES TO THE INCH.

it is situated near the mouth of the river Amoor in Eastern Siberia close to the port of Nikolaievsk. It is operated through a local organization called the Ochotsk Gold Mining Co. Hooper, Speak, & Feilding are the consulting engineers ; C. W. Purington and J. P. Hutchins have examined the properties as dredging experts and are superintending operations. Part of the property known as the Stretensky claim was worked by Russians between 1898 to 1906, but the methods employed were primitive and expensive. It passed then into the hands of a receiver acting on

be of equal value to the part already proved. In 1908 and 1909 Mr. Purington conducted prospecting operations with a Page-Crawford excavator and sluice-box ; his returns confirmed the earlier estimates. The deposit is interesting and unusual ; it extends from the White Mountain to the sea and appears to have been produced by the erosion of the volcanic rocks forming this mountain. The gravel consists of rhyolite fragments which are worn into small pebbles. On the slopes of the mountain there are layers of clay due to the decomposition of the rhyolite, but elsewhere the

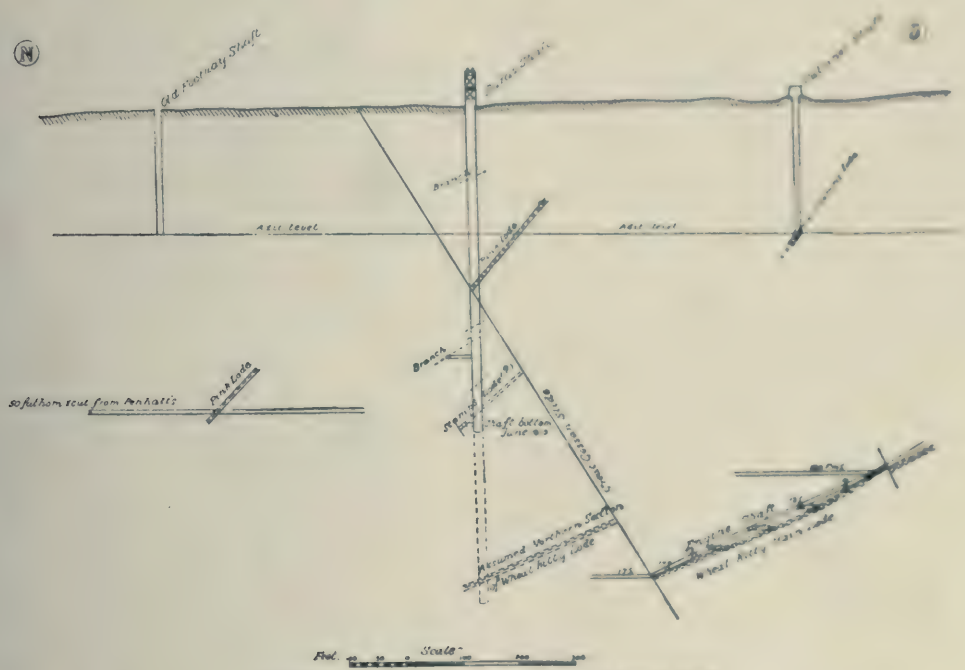
gravel is free from this constituent and is extremely easy to work. The depth averages 18 ft. and the top is not covered with much earth. The trees can be felled and removed at a low cost. The gold is small, powdery, and never flaky; it is easily amalgamated. Nuggets are never found and it is seldom that pieces weigh 2 dwt. Recovery will therefore be easily conducted and little opportunity will be afforded for gold-stealing. The average content of the tested ground is 10d. per cu. yd. but in many places double this amount is found. At a trial-pit 4 miles away and close to the sea the content was 22d. per cubic yard. Early this year an order was given to the New York Engineering Co. for a 7½ ft. close-connected dredge to be operated electrically. This will reach Nikolaievsk before the winter, and will be ready for operations in August 1911. A generating station for electric current is being built at Lake Chla 10 miles away, steam being raised from wood fuel. In addition to the Kolchan property, the company also owns the Pokrowsky claim, which was located by Mr. Purington. As regards climate it is found that the winters are not of that severity usually associated with Siberia. Being on the seaboard and at latitude 53° N. the temperature does not often fall below zero Fahrenheit. The running streams are not usually frozen, nor the surface of the ground for any depth. It is expected that the dredging season will extend to 250 days, and according to the most recent information obtained from regularly recorded observations of temperature the probability is that the season will actually be longer than this. The reports by Mr. Purington and Mr. Hutchins are full of interest and reflect an enthusiasm based upon facts and experience.

Penhalonga.—This company was formed in 1898 by the Anglo-French Exploration Co., to acquire a gold property in the Umtali district of Rhodesia that had previously been worked several times. The ore contains gold and silver amenable to amalgamation, together with galena and cupriferous pyrite containing the precious metals. It is of low grade and the exploitation has always proved difficult. A 40-stamp mill was erected in 1903, together with concentrating machinery, and another 40 stamps were added later. The only dividend was 6% for 1907. The issued capital is £275,000 and there are £199,350 of debentures, some issued in 1905 and the others in 1907. The report of the consulting engineer, C. R. Pinder, for the year ended December 31 shows that the content of the ore is rather lower than during the previous year. The amount of ore mined was 198,604 tons, and after removing 41% of waste, 116,278 tons was sent to the mill. Only 60 stamps were running during the greater part of the year, owing to more waste being removed before treatment. The average assay of the ore sent to the mill was 4·2 dwt. gold, 2¾ oz. silver, and 28½ lb. lead per ton. The recovery was 3·47 dwt. gold, 27 dwt. silver, 16 lb. lead, and just under ½ lb. copper. The total recovery was 20,149 oz. gold, 156,265 oz. silver, 943 tons lead, and 35 tons copper. Of this, 8710 oz. gold and 7571 oz. silver were obtained by amalgamation, and the remainder was produced from 2424 tons of concentrate which was shipped to smelters in Europe. The amount received for the amalgamated bullion was £37,844 and for the content of the concentrate £74,140. Against the latter is £15,154, the cost of shipping and smelting. Mining, milling, development redemption, and other costs brought the expenses to £104,305, so that the profit at the mine was £7680. Other costs included debenture interest £11,961, depreciation £7997, London and other expenses £2069. The credit side was increased by £393 refunded from income tax and a few small items, such as transfer fees. The eventual result of the year's operations was an adverse balance of £13,900. A notable feature of the operations this year was the more liberal sorting. As regards ore reserve, the figures on December 31 were 150,175 tons of developed ore and 51,000 tons of probable ore. This is lower than a year ago, for the reasons that much of the material included a year ago will now be rejected by sorting and some of the probable ore included last year has proved to be unprofitable. The financial position of the company is serious, the debenture interest having been in arrear since October 1909. An attempt was made to raise funds by reconstruction so as to carry out a scheme of development suggested by Mr. Pinder and by H. A. Piper, but shareholders did not respond. The future of the company is uncertain.

Foldal Copper & Sulphur.—This company was formed in 1906 to acquire an old mine at Foldal, in Norway, containing cupriferous pyrite valuable chiefly for its sulphur content. The property was examined by F. Robellaz, Stanley E. Clay, and W. H. Lund. The last named is now manager and W. A. Carlyle is consulting engineer. The first thing to be done by the company was to put the old workings in order. Insufficient support had been provided and at the same time much of the ore had been left behind on either or both walls. In order to make the workings secure the old stopes from No. 2 level to the surface have been filled by flushing with a filling of sand and fine rock. About 120,000 cubic metres of this material has been introduced. The main workings consist of three adits 3500 ft., 3400 ft., and 1500 ft. long, respectively, together with winzes, rises, and cross-cuts. Three inclined shafts have been sunk from No. 2 level at distances of 200 ft., 1685 ft., and 2855 ft. from the entrance. No. 3 level is to be driven at a depth of 200 ft. vertical or 250 ft. on the incline below No. 2 level, and the work of driving from the bottom of each inclined shaft has already begun. The shafts are in ore all the way and if the drifts continue in ore, it will be safe to estimate the reserve between the two levels at 300,000 tons. By the end of the current financial year it is hoped that the reserve will be sufficient to make a regular output of 110,000 tons per year. The report for the year ended February 28 shows that 97,503 tons was mined, and, after dressing part of the ore, 67,453 tons was shipped. The average content was 46·6% sulphur and 1·813% copper. The profit on sales was £13,356. From this has to be deducted London expenses £2440, and interest on loans, debentures, etc. £7480, leaving a balance of £3447, which has been used for reducing the 'formation expenses' account. The company is weighted with capital, there being £110,000 in preference shares and £200,000 in ordinary shares, £22,700 debentures, and a loan of £49,212. No dividend has yet been paid on the preference shares; and as the dividend is cumulative at 6%, the arrears are mounting. The prospects for the future depend on luck in finding wide lenses of ore. At present the veins are from 1 to 3 ft. wide, but there is always a chance of finding much wider parts, for such formations are common in Norwegian pyritic deposits. The resources may also be increased by finding parallel veins of importance; cross-cutting has already revealed the existence of such veins and further research is to be undertaken by means of the diamond-drill.

Willoughby's Consolidated.—This company was formed in 1894 to consolidate various interests acquired by Sir John Willoughby in Mashonaland. The issued capital now stands at £522,296; there is a debenture debt of £83,715, and loans otherwise obtained

£38,583. Among other subsidiaries the company floated the Surprise, the Gaika, the Chicago-Gaika, and the Rhodesia Chrome mines, and still holds large interests in them, though no revenue comes from the investments as yet. The company also works 12 other gold properties on its own account or leases them to tributors. Of these the Queen's is at present the most important; a 10-stamp mill is at work and produced during 1909 7942 oz. worth £33,471 at a mining cost of £18,614. Another, the Eileen Alannah, seems to promise well, as the developments have proved 130 ft. on the 200 ft. level averaging 1 oz. over a width of 12 ft. The company owns a great number of claims and has land and water interests as well as mines. Much of the profit is made by the re-sale of property and realization of investments. The profit and loss account for 1909 shows a revenue of £72,109 of which £34,141 came from gold produced at the mines worked by the company and £12,218 from tributors' royalties. The 14,000 preference shares of 10s. each and bearing 10% dividend are being offered to shareholders and others. The money thus received £7000 will also be sufficient to provide additional dressing and pumping plant. The shaft has four compartments and measures 11 by 7 ft. inside timbers; it is a good example of modern practice. The working cost during the half year shows a decrease, and, considering the small scale, the number of different workings, and the large proportionate amount of development work, shows a careful attention to business. The total cost was 23s. 5d. per ton of which 7s. 11d. was for mining, 4s. 10d. for development, 2s. 6d. for pumping, 5s. for dressing, and 3s. 1d. for repairs and administration. In addition royalties of 1s. 7d. brought the expenditure to 25s. per ton. During 1909 the corresponding figure was 25s. 6d. and during 1908, 26s. 11d. It must be remembered that old-fashioned Cornish stamps and dressing plant are still employed, as the company has never had any ex-



WHEAL KITTY MINE. Section through Sara's Shaft.

expenditure in Africa and London was £46,021, leaving a balance of £26,088, which was carried forward. The directors speak hopefully of the future.

Wheal Kitty and Penhalls.—We gave an account of this tin mine at St. Agnes, Cornwall, reopened a few years ago by J. H. Collins, in our issues of September 1909 and February of this year. The report now issued covers the half-year January to June. The extraction per ton is less than during the previous four half-years, but as the stamps treated a greater quantity of ore and the price of tin was higher, the total receipts show an increase. The ore treated was 7191 tons, and the concentrate recovered 121 tons, being a yield of 37·7 lb. per ton. The average price received was £94 and the receipts £11,402. The new main shaft, Sara's, is now down 560 ft. and drifts are being cut east and west on a lode met at 540 ft. It is the intention to continue sinking another 300 ft. in order to reach the Kitty lode at depth; in order to supply the necessary funds tensive supply of capital. In the profit and loss account for the half-year the total receipts were £11,643, and the costs £8984, leaving a balance of profit of £2659. From this, £609 has been allowed for depreciation of plant, etc., and £778 has been written off the cost of Sara's shaft. The balance with £1906 brought forward from 1909 gives a disposable balance of £3177. In order to leave funds for working capital a dividend of only 2½% for the six months is being paid, absorbing £664, so that £2513 is held in hand.

De Lamar.—This company owns a gold and silver mine in Owyhee county, Idaho, and was floated in London in 1891. For five years the profits were high, but on the exhaustion of the chief veins the dividends sank to next to nothing. Recognizing that the mine might continue to be profitably productive on a smaller scale, the capital was reduced in 1909 from £400,000 to £80,000. During the nine years since, the total distribution has been 92% on the smaller capital. The report for the

year ended March 31 shows that the mine continues to yield profitable ore, which is obtained chiefly by picking the old fillings, scraping the stopes, and prospecting for stringers and bunches. In this way 44,961 dry tons (of 2000 lb.) was sent to the mill during the year, the average assay being $8·41 in gold and $3·23 in silver. The extraction was 17,121 oz. gold and 180,114 oz. silver, leaving $0·95 gold and $1·51 silver in the tailing. The revenue was £91,604 from sale of bullion, and the costs at the mine and in London were £88,967. The company also received £398 from the sale of obsolete stores and £1172 from interest on loans. The available balance of profit was £4142 and £4000 has been distributed as dividend. The company has a reserve fund of £27,000 invested in loans at short call. The report of the manager, Ernest V. Orford, shows that during the year £2000 has been spent on additional concentrating plant consisting of 8 Deister slime-tables and 2 Wilfleys, the object being to make a better separation of the refractory constituents of the ore found below the 8th level. By means of this plant the extraction of the silver will be greatly improved.

Mexican Light & Power.—This is a Canadian company with head office at Toronto. It was formed five years ago to supply electric light and power in the City of Mexico and neighbourhood, and in El Oro. A hydro-electric plant was erected at Necaxa, the necessary water being accumulated by means of dams. Control changed hands in January 1909, when a majority of shares was acquired by the Mexico Tramways Co. R. C. Brown was then appointed managing director and E. D. Trowbridge general manager; C. H. Kearney the engineer continued in charge of the constructional work. In May of last year some of the material constituting one of the dams slid into the reservoir. Fortunately little extra expenditure was occasioned by this accident but the completion of the dam was delayed six months. The seriousness of this contretemps was much exaggerated in the Press at the time. On December 31 the five reservoirs had a capacity of 28 thousand million gallons and when the present work in hand is completed the capacity will be 38 thousand million. On December 31 the connected load was 83,000 horse power. The maximum load when the installation is completed will be 100,000 h.p. As the demand for current has been greater than the possible supply of the uncompleted hydro-electric plant, steam-plant has been operated for the last three years at Mexico City. This has occasioned extra expense of which half has been charged against revenue and half placed to capital account. The capital of the company is $2,400,000 in 7% preference shares and $13,585,000 in ordinary shares; there are $11,865,000 debentures, and $7,024,188 loans secured by 8 million dollars of second debentures. The gross earnings during 1909 were $3,004,153 and the cost of operation $625,403; $493,742 was charged against revenue, being half of the extra expenditure in connection with the steam-plants. After making allowance for difference in exchange and bad debts the balance of revenue was $1,872,246. During the year the company has purchased the business of the Irrigadora electric light and power company at Pachuca, 65 miles away, the price being $3,750,000 payable half in cash and half in debentures of the reorganized Irrigadora company. The plant of this company will be closed when transmission lines have been erected to carry the current from Necaxa to Pachuca. This is expected to take place next month.

Frontino & Bolivia.—This company was formed in 1864 to work gold mines in Colombia, South America. For many years satisfactory dividends were paid, but none has been distributed since 1901; in addition further working capital has been raised by the issue of preference shares and debentures. The capital now stands at £140,000 in ordinary shares and £23,390 in 10% cumulative preference, while the debentures issued amount to £45,138. The output for the second half of 1909 was 11,151 tons of ore producing 9481 oz. gold worth £40,570, and the cost at the mines was £41,686. This production is about 2000 oz. less than during the first half of 1909 from about the same amount of ore. The ore came chiefly from three mines Silencio, Salada, and Marmajito. Since the close of 1909, the value of the ore has increased and the output for the first five months of 1910 is reported at £48,028. The report of the engineer, George P. Chaplin, shows that much expense and trouble is caused by the unsatisfactory supply of water for driving the electric plant and he foreshadows further expenditure in this direction. The mines are far from easy to work; the depth of workings, the nature of the deposit, and the climate, wet and warm, all militate against low costs.

Associated Gold Mines of Western Australia.—This company was formed in 1894 to acquire the Australia and adjoining leases at Kalgoorlie, and up to March 31 last the total production of gold has been worth £2,893,226 extracted from 1,037,955 short tons. A résumé of the history of the company was given in our issue of September 1909 when it was recorded that the reserve of ore was estimated at 483,517 tons averaging just under 10 dwt. Since then the shareholders have suffered many rude shocks, as regards both the current extraction and the estimation of reserve ore. The directors in issuing their report for the year ended March 31 apologize for the failure of the method of sampling telluride mines at Kalgoorlie. During the first nine months of 1909, the monthly output of ore, averaging 11,500 tons, had been yielding gold worth £21,000. In November the yield began to drop, and one of the directors, A. H. Collier, was sent to investigate. The cause for the fall was attributed at the time by the manager, George M. Roberts, to difficulties with water in one of the shafts and a collapse of ground in one of the stopes. Mr. Collier confirmed what was told him, but his report also showed that this particular stope was yielding the best quality of ore, and that its collapse revealed the poverty of the ore at the back. Subsequently Mr. Roberts estimated the reserve at 553,000 tons averaging 6¾ dwt., but on June 17 he withdrew this estimate by cable and reported that the ore sent to the mill contained only 6 dwt., adding that the outlook was very discouraging. E. H. Liveing, the company's consulting engineer, went at the end of May to investigate. His cabled report says that the reserve ore is low grade and pockety, and that the prospects at depth are discouraging; his detailed report is awaited with anxiety. During the year ended March 31, the mill treated 136,829 tons and produced gold worth £228,351, being an extraction of 33s. 4d. per ton. The mining cost was £54,489, milling and cyaniding £79,878, and other expenses brought the costs to £141,596. Development cost £30,021, and there were other small items of receipts and expenditure. The dividend paid absorbed £49,536 being at rate of 10% on the issued capital. Though £69,000 has been spent during the last few years on improvements in the metallurgical plant, Mr. Liveing advises a renewal of the roasting furnaces on different lines, as the old ones are worn out. At the shareholders' meeting the directors' extra remuneration, £990, was vetoed, the fees, £1450, being considered quite sufficient, and Benjamin Brookman and Edward Hooper were elected to the board in place of the retiring directors, B. C. Hinman and John Waddington.

PRÉCIS OF TECHNOLOGY

Ore Deposits of Kalgoorlie.—In our last issue we quoted at length the articles on the geology of Kalgoorlie written by C. G. Gibson and published in the *Monthly Journal* of the Chamber of Mines of Western Australia. A further article by Mr. Gibson on the ore deposits of Kalgoorlie appears in the *Journal* for May. The lodes are vertical zones of rock usually continuous with the surrounding country; they are situated along lines of shearing and faulting, which, by foliating the rock, allowed mineral-bearing solutions to circulate. Mr. Gibson divides the ore deposits into groups according to the nature of the rock in which they are found, namely, (1) quartz-diabase, (2) calc-schist, and (3) acid amphibolite. The first class contains two types of orebody, the quartzose and the schistose, of the same origin and passing gradually into each other. The quartzose is more regular in occurrence and value, as may be judged by the fact that the orebodies of the Great Boulder, Horse-Shoe, and Ivanhoe mines are of this type; more replacement has taken place, the original lode matter having been replaced gradually by a dark compact cherty quartz. The schistose orebodies have been less changed and such alteration as has taken place is due to carbonation. The degree of replacement in the quartzose lodes is always greatest in the inner portions of the lodes. Frequently both types of lode, but especially the quartzose, show signs of secondary movement and re-opening. The middle of the lode is brecciated, proving that the original material has been broken up and re-cemented by fine-grained intergrowths of quartz and calcite. The schistose lodes vary from a solid mixture of carbonates to a slightly carbonated sericite. They are more irregular in size and in the distribution of valuable content than the quartzose. Along the centre of the schistose lodes there is usually a small well-defined seam of quartz with carbonates of iron, etc., about a quarter of an inch thick. Mineralization has been most extensive where the foliation and crushing have been most intense and as this alteration of the rock has been irregular so the ore deposits vary greatly in thickness. Also in the main lodes the gold-bearing orebodies have a lenticular shape sometimes following the extent of the shearing and at other times with no apparent relation. The orebodies on the same lode vary greatly in length but as a rule the smaller ones are equally persistent in depth with the wider ones. The spaces between the lenses are never barren, but the gold content is too low to be of economic value. These lodes are fairly numerous and they are approximately parallel, so that in prospecting and development work it has been customary to cross-cut and to use the diamond-drill freely. The gold exists native and in the form of tellurides; after these comes the auriferous pyrite, which is always richer in gold when fine-grained.

The calc-schists do not contain any quartzose orebodies, and the lodes found in these rocks are similar in every way to the schistose orebodies in the diabase, but they are more patchy and of lower grade. In this class of deposit the most notable was the Oroya chimney, which was a flatly inclined pipe with a maximum diameter of 100 ft. It was worked for nearly a mile on the Brownhill, Iron Duke, Oroya, and Australia East properties and persisted to a depth of 1200 ft. The deposits in the acid amphibolite are found in lodes similar to those in the diabase and schist but so far their value has been small. The chief point of difference is that the lodes contain small rich quartz veins and leaders. These have been worked at Hannan's Reward and on Cassidy hill. At first each small leader was mined separately but subsequently the whole width of lode was extracted, the unusual richness of the small veins compensating for the low value of the rest of the lode. Most of the gold obtained in the alluvial deposits on Hannan's hill has undoubtedly been derived from the weathering of this class of vein. Auriferous lodes are also found in the amphibolite at the contact with the peridotitic dikes. These veins are small and erratic, but occasionally rich. Typical examples are found in the Hidden Secret and Fairplay mines.

Faults are common in the quartz-diabase and calc-schist areas. The main system runs approximately parallel to the general strike of the lodes and dips at 40° to 45° to the west. These are reversed faults and are due to the over-thrusting of the western portion of the belt. Occasionally there are normal faults dipping east. With both classes of faults the displacement varies from 10 to 40 ft. The reversed faults are persistent in dip as well as strike and can generally be followed from level to level. They are marked with a seam of calcite or gypsum, but sometimes contain no filling, in which case they act as water-channels. It is seldom that any gold or mineral has accumulated along the faults between the two portions of a lode. With regard to the chances of ore deposits continuing to a great depth, Mr. Gibson is of opinion that the lodes are undoubtedly persistent and will continue as far as mining operations can follow them. But as regards their gold content, he is not prepared to prophesy.

Geological Survey of West Australia.—The aim and scope of the West Australian Geological Survey is once more engaging the attention of the Government, a petition in favour of extending its usefulness having been presented by the Chamber of Mines. Before proceeding to quote the recommendations it is advantageous to refer to a paper recapitulating the history of the Survey read by A. Gibb Maitland, the chief, at a meeting of the Natural History and Science Society of West Australia, and published by the *West Australian Mining Journal*. The first mineral discoveries in Australia were made in 1842 when lead and copper deposits were found in the Northampton district of West Australia, situated near the coast north of Geraldton, and this was the first State of the Australian continent to employ a geologist on its official staff. The position was held by Ferdinand von Sommer for the four years from 1847 to 1851. He travelled widely and made special geological studies of the Victoria, Toodyay, and York districts, inland from Perth, and also made general examinations of the tract of country between these districts and Mount Barren on the south coast near Hopetoun. His maps and reports were never published but research has unearthed three articles by him appearing in the current literature of the time and the original drawings of his maps have been discovered and are now in the Museum. During the next twenty years the brothers Gregory did some good work. From 1870 to 1873 H. Y. L. Brown occupied the post of Government Geologist and prepared three maps and ten reports relating chiefly to the southern and coastal districts. One of the most interesting was a fairly detailed map of the coast extending from Doubtful Bay to Geraldton. Mr. Brown's regime was made additionally interesting by the fact that under his advice the first supply of artesian water was obtained by boring a few miles southeast of Perth not far from the foot of the Darling range. In 1873 his engagement terminated because the Government could not afford the expenses of a geological survey, although the Governor admitted that the available information pointed to the existence of valuable deposits in vari-

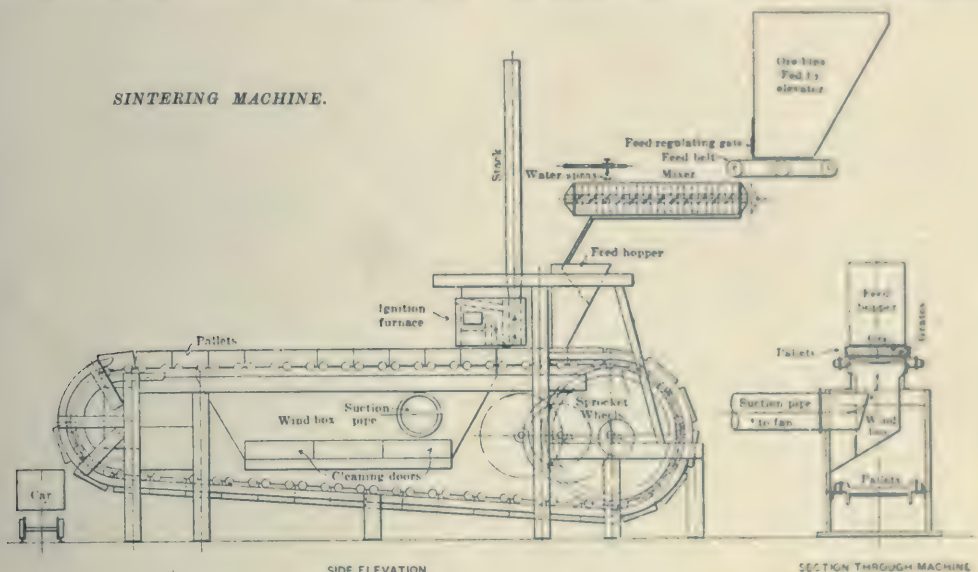
ous parts of the State. After a lapse of nine years the post was re-created and E. T. Hardman, a member of the Irish Geological Survey, was appointed. His work was centred on the Kimberley district at the extreme north, and he produced two voluminous reports together with many maps. These greatly stimulated prospecting and his prediction as to the localities where gold would be found were subsequently justified. As a result Kimberley was the first declared goldfield. After his return from the north, Mr. Hardman examined the district inland from Bunbury and south of Perth, and his work here ultimately resulted in the discovery of the Greenbushes tinfield. His engagement unfortunately lasted only two years and he returned to Ireland in 1885. There was an understanding that if the post of Geologist was made permanent he should have the first offer. For two years the Legislative Council discussed ways and means for providing funds for an adequate survey, and for a long time science had an enemy in the ignorant. One member who remarked that he "had no faith in these scientific gentry" appears to have had too many supporters. Meantime C. G. Nicolay did some good work while in charge of the geological museum at Fremantle. In 1887 opposition was over-ruled and funds were voted, but sad to relate, Mr. Hardman's services were not available as he had not long before succumbed to an illness brought on by exposure incidental to his duties in Ireland. Failing Mr. Hardman, the post was offered to H. P. Woodward and he held it from 1888 to 1895. During the first part of the time he was assisted by B. H. Woodward who acted as curator and assayer and later by S. Goczel who helped as field geologist and mining engineer. The work done by this increased staff naturally covered more ground. Maps and reports were prepared relating to the Collie and Irwin coalfields, the Greenbushes tin district, and the country stretching between Nannine and Esperance bay, including Cue, Yalgoo, Goongarrie, and the Murchison goldfields generally. One of the most valuable pieces of work was the production of a geological map of the whole of Western Australia on a scale of 50 miles to the inch. This map added greatly to the knowledge of the geology of the State and is still considered by Mr. Maitland to be the best extant of the region east of the 120° meridian. The total number of publications during Mr. Woodward's regime was 21 reports and 6 maps The Geological Survey was expanded in 1896 and took the form with which we are familiar. The staff now includes topographical surveyors and petrologists and the assay department undertakes free assays with a view to helping the poor prospector and obtaining informationn not otherwise available. The Survey also has a special department devoted to water-supply. Geological inquiry so far has naturally consisted of a series of unconnected observations. Nevertheless it has been possible to make some broad generalizations. Little or no progress has yet been made in the correlation of the various geological horizons with those of the rest of Australasia and of other neighbouring countries.

The report of the committee of the Chamber of Mines submitted to the Minister refers to the steady decline in the output of gold and urges that other parts of the country must be investigated. Much prospecting has recently been done by individuals and by corporations with little or no success, and the Chamber feels that some additional scientific lead is necessary. The recommendation is that 25,000 square miles of the schistose rocks of igneous origin known to be generally favourable should be prospected by two parties of three each, the cost of which over two years is put at £5000. The duty of such parties would be to connect the known goldfields, to describe the geological conditions most favourable to auriferous deposition in any given area, to indicate the spots where these conditions are fulfilled, and to indicate areas to be avoided by prospectors. A further recommendation covers the search for new goldfields in districts not hitherto known to be auriferous. In this case the cost would be greater and a wider range of specialists would be required. A party should consist of eight men, namely a geologist, a surveyor, two prospectors, a cook, and three camel-men. The cost would be £2500 per annum with seven months in the field, and it is supposed that 1000 square miles per month could be covered. The district most suitable for this class of work is the tract extending from the eastern border to Edjudina and Wiluna. For these two purposes the Chamber asks that an extra grant of £5000 per annum for two years should be given to the Geological Survey. Finally, it was pointed out that the individual prospector has little inclination or opportunity to traverse these tracts of country owing to their providing no means of sustenance. The Minister of Mines did not give a hopeful answer, mentioning that during the last year or two the general depression had made it necessary to reduce the expenses of the Survey. He was inclined to adopt the proposition to connect the surveys of the various goldfields, but did not think that the proposition to prospect unknown regions would be acceptable to the Government.

Dwight-Lloyd Straight-line Sintering Machine.—In the June *Bulletin* of the American Institute of Mining Engineers there is a valuable paper by H. O. Hofman reviewing present practice in America in connection with pot-roasting and sintering. He collects together all the published information relating to the Huntington-Heberlein, Savelsberg, Dwight-Lloyd, and analagous processes, and shows how the first named has been modified to meet the requirements of various ores, especially in custom plants. From these modifications came the discovery that lime was not an essential, so paving the way for the application of the method to other ores than those of lead. Much of the information in the paper is collected from articles already published. The Dwight-Lloyd straight-line sintering machine is employed at the Ohio & Colorado Smelting Refining Co.'s smelter at Salida, Colorado, and at smelters in Illinois, the Mississippi valley, and at Helena, Montana, but does not appear to have been described before. The Young machine, which was described in our May issue, is designed on similar lines, but has not had the same trial in actual practice. The construction of the Dwight-Lloyd machine is shown in the illustration. The ore is fed upon a travelling grate in the form of an endless conveyor made of small truck-like elements called 'pallets,' all independent of each other, each of them having four wheels running on guide rails. While passing over the suction-box the pallets glide along the top of the sides of the box on their planed bottoms instead of on the rails, and at each end of the suction-box a planed plate is provided on the track for the pallets to glide over, thus preventing any leakage of air. The little wheels engage in the teeth of sprocket-wheels to the right, and these push the train of pallets along. At the discharge end, to the left of the drawing, the guide-rails raise the pallets slightly so as to dislodge the cake of sinter from the grate-slots. On passing round the circular guides each pallet falls and the concussion throws the cake into the car. The return journey is made by gravity along the inclined guides at the bottom. The igniter is a small furnace burning coal and built of

tiles. The flame after passing over the fire-bridge is deflected downward upon the ore by an adjustable brick hood. The machines vary in size. That at Salida measures 30 ft. long over all; the distance between the brick hood and the surface of the ore is 2 in.; the rate of travel is 8 in. per minute; the vacuum in the suction-chamber is 6 oz.; the igniter burns 1000 lb. coal per 24 hours. The charge is a low-grade mixture containing 17½% sulphur and 35% silica; the discharged sinter contains 4% sulphur; and the capacity is 50 tons per 24 hours. One man attends to the machine, but could equally well look after others. The cost, including delivery of ore over 200 ft. and of sintered material over a similar distance, is 3s. per ton. At a plant in Illinois 100 tons of high-grade lead ore is treated per 24 hours, and the cost is 2s. per ton. The horse-power consumed varies with the nature of the material treated. The power used in the mixer and for driving the pallets varies from 2 to 6 h.p., and that required by the fan for generating the suction varies from 12 to 20 h.p. As regards the sizes of the particles it is found that none should be greater than ¼ in. and that not more than 25% should be as large as this. In practice it is found that some of the sulphur escapes as vapour and is deposited in the suction-chamber. Also from 3 to 5% of the fine ore passes through the grate and accumulates below. These are removed from time to time through doors provided for the purpose. It is necessary that the constituents of the charge should be intimately mixed and uniformly moistened with from 6 to 10% of water. The mixture should be made in such a way as to produce a slag that forms at a low temperature and requires little superheating to become fluid. The range of practicable silica is from 10 to 35%; it is better to have an excess of iron over lime than the reverse; 18% is a good average for the sulphur, though 10% can be used, and, if the sulphur content has not to be greatly reduced, the initial amount might be as high as 25 per cent.

SINTERING MACHINE.



SIDE ELEVATION SECTION THROUGH MACHINE

Compressed Air at Cobalt.—In previous issues we have made several references to the supply of compressed air to the Cobalt mines obtained by the Taylor process at the Ragged Shute falls and transmitted 9 miles through mains. We gave an account of the plant in our May issue. The *Engineering and Mining Journal* for July 9 gives particulars of an unexpected effect in connection with the character of the air supplied. On being used in the mines it was found practically impossible to keep candles alight, though apparently the miners were not affected. On an analysis of the air being made it was found that the content of oxygen was only 17·7%, or about 3% lower than that of the atmosphere. At first it was supposed that some of the oxygen had been absorbed by the asphalt with which the mains are lined, and that later the air delivered would be normal. As no difference was found in the analyses from time to time, another reason had to be sought. It is now found that much of the oxygen goes into solution in the water during compression and is not entirely released afterwards. Though the men do not seem to be affected by this deficiency of oxygen, it cannot be conducive to vitality and activity. The deficiency also makes the effect of the gases from the explosives more serious. Altogether the circumstances attending the use of compressed air produced by falling water gives rise to physical conditions which will require some study and investigation.

The Carbon Electric Cell. — *Metallurgical and Chemical Engineering* for July contains an article on the problem involved in the search for an electric cell in which the energy of the oxidation of carbon is transformed direct into electric current. So far no practicable cell of this character has been invented, but the study is of great importance, for it means the production of current direct from coal as a substitute for the roundabout processes at present in use involving steam engines or gas engines and dynamos. The easiest way of explaining the electro-chemistry of the cell is to consider the Edison nickel-iron accumulator which was described in our issue for March last. Here the reaction during discharge is the reduction of a higher to a lower oxide of nickel on one side and the oxidation of iron on the other; the electrolyte consisting of a solution of potassium hydrate serves as the carrier of the ions, but is not changed in itself during the discharge. This nickel-iron cell is the most successful example of a general type to which the name 'oxygen-

lift cell' has been given. If M and R are the materials of the two electrodes, the equation of the discharge is $MO + R = M + RO$. The ideal carbon cell should be of this type and the equation of discharge would be $2MO + C = 2M + CO_2$. The problem is to find a suitable electrolyte and a material M. But while the Edison cell is an accumulator, the carbon cell is intended to be a primary battery giving a continuous discharge. That is to say when MO is reduced to M during discharge, the intention is to reoxidize it immediately by means of new oxygen from the air. Such a cell would give out a continuous current at the expense only of carbon and atmospheric oxygen. The difference between this reaction and combustion is that the oxygen is brought into contact with the hypothetical M and not with the carbon. Many cells have been tried on these lines but their basis has not been correct and they have failed. For instance the Jacques cell used iron covered with oxide, and carbon, as electrodes, and fused sodium hydrate as electrolyte. The reaction here is however a chemical one between the carbon and sodium hydrate giving sodium carbonate and hydrogen, and the cell acts simply as a hydrogen-oxygen cell, quite a different thing. Junger and Taitelbaum have produced cells using concentrated sulphuric acid as electrolyte, and the latter found vanadium salts suitable for use in connection with the material M. But here again the carbon electrode did not act in the way intended, as the acid oxidized the carbon with the production of sulphur dioxide. The carbon electrode thus became actually a sulphur dioxide electrode. In spite of these failures, the research for a suitable M and electrolyte is a fascinating study and success would work a great revolution in the production of current.

Production of Iron and Steel.—The *Engineering and Mining Journal* for July 9 gives a concise statement of the production of pig iron and steel in the United States, Germany, and Great Britain, which among them account for 80% of the world's production. In the accompanying tables the production for the last three years, 1907, 1908, and 1909, are compared and the figures relating to steel for 1909 are analysed showing the production by each process. The decrease in the figures for the United States in 1908 was exceptional and due to the financial stringency, but the production regained its normal level in 1909. The year 1908 was bad also for Germany and Great Britain; the former has since made up for the fall, but the latter not altogether. The difference in steelmaking practice in the three countries is marked. In the United States the basic open-hearth is at the head followed by the Bessemer converter. In Germany the Thomas-Gilchrist basic converter is the chief factor and the basic open-hearth second. In Great Britain the distribution is more even. The acid open-hearth leads, followed by the Bessemer converter, while the basic processes of the open-hearth and converter account for amounts approximately one-half of the corresponding acid processes. In the United States and German figures, production by the crucible process and the electric furnace is given; the figures for Great Britain are not available.

While writing of iron and steel production we would call attention to two recent publications relating to the future resources of iron ore. One is the voluminous report on the subject prepared for the Stockholm International Geological Congress, and the other is an article by Henry M. Howe in the *Atlantic Monthly*. The latter is intended to disabuse the public in general and Wall Street in particular of the idea that there are no other iron ore deposits in America but those of Mesabi, a misapprehension that seems to be widespread.

PIG IRON PRODUCTION.

	1907	1908	1909
United States....	26,193,863	16,190,994	26,208,198
Germany.....	13,045,760	11,813,511	12,917,653
Great Britain....	10,082,638	9,438,477	9,818,916
Total.....	49,322,261	37,442,982	48,944,767

STEEL PRODUCTION.

United States....	23,735,737	14,247,619	24,338,302
Germany.....	12,063,631	11,186,379	12,049,834
Great Britain....	6,627,112	5,380,372	5,975,735
Total.....	42,426,480	30,814,370	42,353,871

METHODS OF STEEL PRODUCTION.

	United States Tons	Germany Tons	Great Britain Tons
Converter:			
Acid.....	9,480,076	151,148	1,128,819
Basic.....	—	7,517,451	632,133
Total.....	9,480,076	7,668,599	1,760,952
Open-hearth:			
Acid.....	1,093,687	311,812	2,807,369
Basic.....	13,632,152	3,967,581	1,407,414
Total.....	14,725,939	4,279,393	4,214,783
Crucible, etc.....	109,073	84,067	—
Electric	23,314	17,773	—
Total.....	24,338,302	12,049,834	5,975,735

Marriott's Square Fathom.—At the June meeting of the South African Association of Engineers, W. W. Mein read a paper entitled: 'Rand Mine Returns with Special Reference to the New Fathomage System.' Mr. Mein is an engineer of high standing connected with the same group as Mr. Marriott, and is the responsible man at the Robinson, Village Deep, Ferreira, the Modderfonteins, and other mines. He is not a believer in the new fathomage system, considering that it is not only based on a misconception of facts but is no help whatever to the engineer who wishes to keep a sharp eye on costs. Mr. Mein's paper is a lengthy one and a full abstract is beyond the limits of our space. Indeed it is a paper that ought to be read in full for it is brimming with fact and argument based on a long experience. Naturally much of the discussion and criticism will only be understood by those who have Mr. Marriott's tables before them, and the detailed discussion of the fathom scheme is only of interest to those immediately concerned; but other parts of the paper deal with the subject on broad lines, so making the arguments applicable to mining generally.

Mr. Mein does not know whether Mr. Marriott's system is intended to be applied for the benefit of the engineer or of the public; it is obvious that accounts and records are kept for both purposes and the information is not necessarily the same in each class. If the scheme is intended for the benefit of the public, Mr. Mein does not see that the public wants it, for the accounts both monthly and yearly at present sent to the shareholders have always given satisfaction and have been considered models of conciseness and clearness. On the other hand Mr. Marriott's scheme is of no use to the engineer who supervises the daily work above and below ground. In order to keep track of the cost, efficiency, and results of stoping, full daily records must be kept of tonnage stoped, and a monthly summary made. A three-monthly period is too long

from every point of view. In his paper Mr. Mein describes in detail all the heads of information recorded in the daily reports. The only occasion for using the fathom in Mr. Mein's routine is in calculating the stoping efficiencies, and he points out that it is just here that Mr. Marriott omits the fathom from his scheme and goes back to tonnage, for the latter in his pamphlet says that "according to the ease of extraction or refractoriness of working, a certain set *standard of tonnage* is demanded from each worker employed, and from explosives, fuses, and other accessories." Mr. Mein draws attention to the fact that a lengthy experience of mining has demonstrated to him that standards of tonnage cannot be assumed, and that the methods adopted by him and others are intended just for the purpose of ascertaining to what extent the actual tonnage can be brought toward perfection.

In the next section of his paper Mr. Mein describes how records are made of development and mining work according to the system now in vogue at the mines of his group, and he shows that the variation in the content of the ore is far too great for it to be possible to calculate the value of the reserve or of the ore stoped by the area of the reef blocked or exhausted. This part of the paper, as with the other parts already referred to concern the Rand engineer solely. What follows is however of concern to all engineers working in any part of the world and on any class of deposit, for he introduces facts which directly controvert the arguments brought forward by Mr. Marriott and others who consider the 'low cost per ton' a false god. Mr. Marriott is in favour of mining less low grade ore and in his pamphlet gave examples to prove that by excluding the poorer parts and mining only the better quality an equal profit could be made with a much smaller plant. His fundamental case was ore worth 30s. per ton costing 20s. to mine and treat, with a similar thickness of ore on the hanging wall containing 15s. per ton. He assumed that the cost of mining and milling this lower grade ore would be 15s., and argued therefore that no profit was made by treating it, though the engineer would point with pride to the fact that by including this other ton his costs per ton milled would be 17s. 6d. over the two tons. Therefore, he argued, the lower cost per ton was a delusion and a snare, for the shareholder got no benefit from it, and, in addition, the original capital expenditure on the bigger plant would be much greater. Mr. Mein controverts the statement that the ton of low grade ore on the hanging wall would cost 15s. to mine and mill, and quotes Mr. Marriott who said that this ton "comes into the stopes for nothing" As a matter of fact it would cost something to stope, but the standing charges for pumping, administration, etc., would be nothing, nor would development have to be charged. By reason of a wider stope the cost of labour especially in connection with tramming and shovelling would be less. The cost per ton of the upper ore according to Mr. Mein's reckoning would be nearer 10s. than 15s., and owing to the general benefits obtained by a larger scale of operations the cost of the 30s. ore would be 19s. instead of 20s. Thus in actual practice the cost of mining and treating the two tons, one of 30s. and the other of 15s. a total content of 45s. would be 29s. instead of Mr. Marriott's 35s. and the profit would be 16s. instead of 10s. It is obvious from this difference of opinion between two eminent authorities that close approximations to actual costs must be used in argument rather than hypothetical figures.

STREET SCENE IN JOHANNESBURG.

Another point in Mr. Marriott's scheme was that the richer ore should be worked first and the poorer at some later period when costs had been reduced. Mr. Mein takes up this subject in detail and employing the theorem of present values shows that concurrent working of the two grades on a large scale is more profitable than working the richer first and the poorer afterwards with a smaller mill. With similar ore to that in the case above cited Mr. Mein supposes a mine containing 10 million tons of 30s. ore and a similar amount of 15s. ore on the hanging wall. This may be treated (1) by Mr. Marriott's system with a plant to treat 500,000 tons per year, and (2) by Mr. Mein's

method, taking 2 tons of the richer to 1 of the poorer. According to scheme (1) 500,000 tons would be treated every year at 10s. per ton or £250,000 profit over 20 years. Taking 7% as the desired interest on the investment and 3% for redemption, the present value of the deposit would be £2,331,743. At the end of the 20 years, another 10 million tons would remain averaging 15s. Owing to the expense connected with filling the old stopes and of reopening, the cost of treatment would not be less than 12s. per ton, leaving 3s. profit. The yearly profit by treating 500,000 tons per year would be £75,000. Taking a 20 years' life deferred 20 years the present value would be £201,248, making the total present value according to Mr. Marriott's system £2,532,991.

By scheme (2) taking 2 tons of 30s. ore and 1 of 15s. ore it would be possible to increase the plant by 50% and extract 750,000 tons of ore per year. The average yield of three tons would be 25s. per ton and the cost would be 20s. for the first ton of richer ore, 19s. for the second, and 9s. for the ton of 15s. ore. The average cost would be 16s. giving a profit of 9s. Mr. Mein draws special attention to the fact that the average cost is one shilling greater than the extraction from the third ton, and remarks that with this point lies the fallacy so often introduced by the opponents of wholesale mining, who say that all ore of less content than the average cost should be discarded. Mr. Mein shows by calculation of present values that the inclusion of this apparently unprofitable ore is actually an advantage. The output would be 750,000 tons per year for 20 years at 9s. per ton profit. This would give a present value of £3,147,852. At the end of the 20 years 5,000,000 tons of 15s. ore would be left. This would last 6⅔ years and, assuming the profit to be 3s. per ton as before, the present value of this deferred profit would be £134,706, bringing the total present value to £3,282,558, a figure £750,000 greater than under Mr. Marriott's system. This profit would amply warrant the extra expenditure of a quarter of a million on the additional plant.

Having thus shown a substantial reason for preferring to use low grade ore for reducing costs, Mr. Mein has good cause for considering that the so-called 'low-cost craze' is in fact a sound economic doctrine, and that consequently the expert mine manager does not want to be relieved of the responsibitity of deciding what ore shall be milled and what left behind. Furthermore after having defended his own position he carries the war into the enemy's camp by declaring that high profits per ton bring more abuses in their train than the low cost per ton is alleged to do by Mr. Marriott. For instance it is a direct incentive to work rich ore at first in an injudicious way only too well known both in the field and on the Stock-Exchange.

Standardization of Terms.—The committee of the Chemical, Metallurgical, and Mining Society of South Africa has issued a report recommending certain definitions, spellings, etc., in connection with mining and metallurgical terms. The report is open to discussion by members and others and a final decision will not be taken by the Council until October 31. The recommendations are as follows:—

(1) Except when otherwise necessary, the following words shall be considered collective nouns and used in the singular: Sand, ash, sulphide, tailing, pyrite, telluride, fine, concentrate, slime, black sand, slag, chloride, residue.

(2) The following shall be used in the plural, to indicate the products: Shavings, skimmings, steamings, sweepings, drillings, reserves.

(3) Preference should be given to the singular in precipitate, bin, cost, profit, value.

(4) The following abbreviations shall not have an 'S' to indicate plural: Oz., lb., dwt., gr., cc., cm., kg., in., gal., m., gm., and mm.

(5) Such words as dirt, mullock, and muck, shall not be used.

(6) The following spellings shall be used: By-product, shoot (of ore), by-pass, hydraulicking, syphon, chute (a passage for ore, etc.), kafir, gram, dike, rise.

(7) 'Vat' shall be used instead of 'tank'; 'cyaniding' rather than 'cyanidation'; 'breaking and sorting' instead of 'crushing and picking'; 'ore-slime' to distinguish from 'gold-slime'; 'extraction' to mean the metal extracted from ore, 'precipitation' the metal precipitated from solution, 'recovery' the metal won in a form suitable for market.

(8) In reports on screening, it should be stated whether the number of holes refers to the area or linear measure, and the diameter of the aperture in decimals should be given; the gauge of wire and the percentage of discharge should be given. Temperatures to be expressed in Centigrade with the equivalent in Fahrenheit in brackets. Cyanide and alkali strengths to be expressed in percentages of specified reagents.

(9) A ton shall be 2000 lb.; a fluid ton 32 cu. ft.

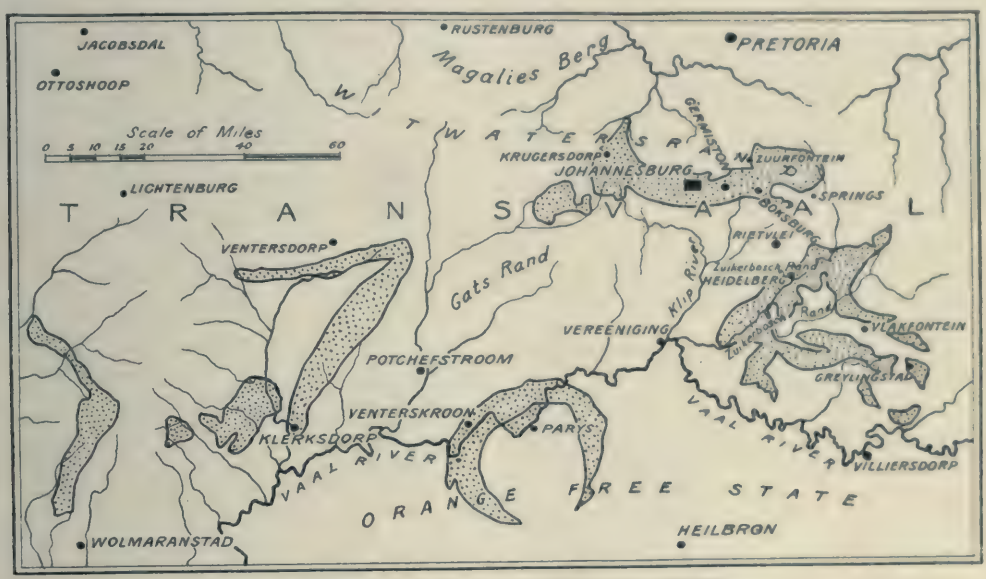
These recommendations are mostly acceptable; but those in (7) require some additional explanation, especially the last three words quoted. Also 'vat' should be used for a vessel in which a chemical reaction takes place, and 'tank' for a storage vessel.

The Larger Rand.—It has been known for years that the Witwatersrand series is found in other parts of the Transvaal and Orange Free State, besides the Rand, but probably most people have forgotten the fact. To revive memories we publish herewith a map based on Hatch & Corstorphine's geological map of the Transvaal. In earlier years prospecting and mining was done in the outlying districts with no satisfactory results. During the current year attention has been directed once more to these deposits both in the Zuikerbosch Rand and in the neighbourhood of Parys in the Orange Free State. The *South African Mining Journal* for July 2 gives a timely article on the subject.

Fifteen years ago much was heard of the Rooderand in the Potchefstroom district, and of the deposits in the Klerksdorp and Heidelberg districts, but such names as the Amazon series and the Jumbo reef, once in everybody's mouth, are now seldom mentioned. However, during the last few months much of this area has been quietly acquired by Johannesburg houses, with the double object of testing old deposits and of investigating the occurrence of ore on the basis of new geological theories. Some geologists have expressed a belief in the possibility of correlating the deposits in some portions of the outlying districts especially Venterskroon with the Main Reef and other series of the Rand. The *South African Mining Journal* sounds a word of warning against this attempt at correlation and quotes J. W. Gregory's description of the irregularity of the deposits within the Rand itself. It is difficult even to correlate the various deposits of the West, Central, and East Rand. For instance in the Durban Roodeport the South Reef is considered to be possibly the representative of the Main Reef Leader of the Central Rand and is the only profitable bed. Again in the East Rand the Main Reef Leader is ab-

sent in some places; the South Reef is replaced by a fine-grained bastard 'reef,' and only the Main Reef is worked. Thus the individual beds vary from place to place, and if one is not gold-bearing another is. Therefore though it is inadvisable to attempt to prophesy the existence of any one particular bed yet there is excellent reason for supposing that wherever the Witwatersrand series is found there are chances for finding deposits of gold.

Among the new geological theories is one which alleges that the Main Reef series, instead of taking an abrupt bend round the Van Dyk curve, and northerly to Van Ryn and Modderfontein, continues southward from Boksburg, and subsequently in a southeasterly direction through the Zuikerbosch Rand, and across the Vaal river towards Heilbron. The thickness of the Main Reef series in the Central Rand is so much greater than that of the series of beds in the Far East Rand at Springs that the entire absence of the Main Reef series at Springs may be legitimately imagined.



OUTCROPS OF THE WITWATERSRAND SERIES.

It is held by many that the whole series cannot have been thinned, and as it is admitted that there is a break between the East Rand Proprietary and the Van Ryn, there is ground for supposing that the Main Reef or upper series pursues a different course, eastward of the Van Dyk curve.

Abe Bailey's company is now prospecting in the Zuikerbosch Rand, west and southwest of Heidelberg, where it is assumed that the Main Reef series will be found below the amygdaloidal diabase. In the crescent-shaped outcrop round Parys, work is being done by the Consolidated Gold Fields and by the Wernher-Beit group. Here the new theory is that the auriferous beds are to be found underneath the Venterskroon amygdaloidal diabase and not in the quartzite. The old Amazon series and the Jumbo reef are therefore not being re-prospected, and bore-holes are being sunk through the diabase. The results of the new work in these outlying districts are awaited with keen interest.

Reverberatories in America.—The fact that the new smelting plant erected at Pine Canyon, Utah, by the International Smelting and Refining Company, consists entirely of reverberatory furnaces and no blast furnace has drawn attention again to the gradual alteration in the metallurgy of copper in the United States. The *Mining and Scientific Press* for July 16 discusses the economic question connected with this growth of reverberatory smelting. At Pine Canyon there are five reverberatories 102 by 19 ft. capable each of treating 250 tons per day. They are primarily intended for the treatment of ore and concentrate from the Highland Boy mine, but custom ore will also be bought. It is notable that the reverberatories are not so long as those at Anaconda. It is now recognized by many metallurgists that no advantage is gained by making reverberatories longer than 80 or 85 ft. The smelting is finished at that distance from the fire-bridge and any additional space could only be employed in allowing of a greater time for the matte to settle. As it is doubtful whether in a shorter furnace the separation of the slag and matte is not just as efficient as in the longer ones there is no advantage; on the other hand heat is being used to no purpose. Here we arrive at one of the main reasons why reverberatories are being adopted, namely, the possibility of utilizing the waste heat for power purposes. The experience at Cananea, as outlined in our issue of November 1909, has shown that the economy in this direction is remarkable; of the heat of 0·77 bbl. of oil used for melting one ton of charge, that of 0·44 bbl. is used for generating steam, and only that of 0·33 bbl. debited to the smelter cost. Another advantage now appealing to American managers is that the reverberatory has greater flexibility in connection with the treatment of variations in the charge, thus showing a different characteristic from the blast-furnace, which requires a greater regularity in the composition of the charge. The advantage that the reverberatory has in the treatment of fine is already well known. The present position of custom smelters is that less ore is obtainable and more fine concentrate, and consequently they are inclined to adopt reverberatories. A reverberatory is more economically worked with a silicious than basic material, as it is easier to obtain a serviceable acid fettling, and basic

dust corrodes the arch and walls. At the present time the fine concentrates bought by custom smelters are more often basic than acid, but in spite of the drawback of the comparative unsuitability of the material due to chemical composition, it is found the best policy to adopt reverberatories. A highly silicious ore is used at the beginning of each charge and this gives the arch and walls a protective coating, thus obviating the difficulties due to basic content. As a confirmation of this policy it is interesting to note that the Garfield smelter, near Salt Lake, is intending to use reverberatories almost exclusively, as the Utah Copper Co.'s concentrators will shortly be delivering large supplies of material from the reconstructed Boston mill.

Diamonds.—There has appeared a further notable contribution to the growing literature on the origin of the diamonds on the arid coast of German South West Africa. This is in the paper read by P. A. Wagner, a young South African geologist (old in diamond problems), before the South African Geological Society. Mr. Wagner draws attention to the occurrence of peculiar olivine-bearing dikes in the Pomona district, where the richest diamond deposits are situated. This work has been determined by Professor Rosenbusch as a "typical amphibole monchiquite." A. L. Du Toit of the Cape Colony Geological Survey has proved the dikes of typical micaceous kimberlite of the Prieska, Britstown, Victoria West, and Carnarvon districts to be "intimately associated with dikes of mica camptonite and mica monchiquite." In the Barkly West division of Cape Colony and also the Pretoria district, dikes of monchiquite have been noted. Dr. Wagner has come to the conclusion that the G. S. W. A. diamonds have been derived from a rock "closely allied to, if not identical with, kimberlite."

Copper and Iron in Cuba.—In the June *Bulletin* of the Canadian Mining Institute, there is a paper by Benjamin B. Lawrence on the El Cobre copper mine situated 12 miles northwest of Santiago bay, Cuba. This is an old mine with a romantic history, and is at present being worked by Americans who ship the ore to New York. The deposit was discovered in 1544 by the Spaniards and was worked by many owners at different times under tribute to the Spanish throne. From 1700 to 1830 the mines were worked as Crown property. In the latter year they were purchased by the Consolidated Company, an English corporation, and the period under this control, extending to 1869, was the most active in the history of the mines. The ten-years' war put an end to the operations of the company though probably difficulties connected with mining at depth also had something to do with the suspension. The ruins of substantial plant characteristic of English methods of mining still remain. The huge cylinders of the Cornish pumping engines and the 60-ton bobs are the wonder of the American visitors. The buildings are of massive stone and are provided with port-holes, showing that means of defence were necessary. The mahogany stull-timbers 24 in. square and 30 to 40 ft. in length were preserved from decay by the sulphate solutions, and after 50 years in the mine were as good as ever. Much of the ore was evidently concentrated, for the ground is covered with jig tailing, and remains of stamp-mills have been found. The landscape is dotted with disused buildings and chimneys of the same type as is characteristic of Cornwall. No less thau 40 old shafts have been found. But the most notable building is the great shrine that used to contain the image of the Virgin Mary; its pink dome and square blue towers are still conspicuous among the ruined buildings and the more modern head-frames. It was not until 1901 that a New York syndicate reopened the mines. The first thing to be done was to rebuild the railway which had been entirely wrecked, and then the innumerable difficulties associated with the reopening of old mines began to crop up one by one. Indeed the history of the past ten years provides an excellent example of this heart-breaking class of work. The shafts were full of debris ranging from old pump rods to cannon balls and skeletons. The water was so highly charged with sulphate as to damage the pipes and pumps. It took two years to get to the 200 ft. level, and another year to the 500 ft. level. Mining was commenced in 1903 and during the year 85,000 tons of 7% ore was extracted, and concentrated and smelted at the works which had in the meantime been erected at the coast. The water from the mines was found to contain 400 grammes of copper per cubic metre and as much of the copper was recovered by precipitation as possible; later the amount in the water became less, and now only 50 grammes is recovered. An attempt was made to treat the oxidized ore by leaching, but the cost and consumption of acid were too great. On going below 500 ft. the old workings were found to be dangerous, and the air was foul. In spite of these worries work was continued until May 1906 when a cave suspended operations entirely. Prospecting of upper levels and of outlying portions of the property was then undertaken and large quantities of ore were found. One surface deposit yielded 64,000 tons of 6% ore, and 100,000 tons of 9% ore was extracted from above the 200 ft. level. The mine is now producing from 3 to 4000 tons per month, and arrangements are in hand to start development at depth once more. It is supposed that the old workings extend to a depth of 1200 ft.

As regards the nature of the ore deposit, the main lode is nearly vertical and the ore occurs in lenses along a brecciated fault traversing rhyolite, rhyolite tuff, coarse-grained porphyry, fine-grained rhyolite and porphyry breccia, and conglomerate. There are also two other smaller lodes. The veins are covered with 100 ft. of gossan, and as far as the American company has gone in depth, rich shoots of sulphides have been found, showing that the limit of the zone of enrichment has not yet been reached.

Mr. Lawrence also gives details in his paper of an iron mine, belonging to the Spanish American Mine Co., and situated 26 miles from Santiago de Cuba. This deposit was opened in 1899 and is now producing 540,000 tons per year of hematite containing 58% iron, 0·02% phosphorus, and 0·25% sulphur. The ore occurs in a series of lenses in cyanite, and is found on the side of a hill. Before mining could be done, the overburden to a depth of 100 ft. and consisting practically of the top of the hill, had to be removed; then the deposit was mined by a series of benches. The same company has recently developed another important property near the north coast of Cuba at Mayari. The ore here occurs on the surface and extends to a depth of 30 ft. It covers a plateau for several miles and it is estimated that there are a thousand million tons averaging 46% iron. The ore is mined by steam shovel and delivered to 50-ton cars, which are hauled to the top of an incline and then lowered by gravity down another incline 3 miles long. It is here discharged on to stock-piles from which it is sent to furnaces, where the hygroscopic water, consisting of 31% of the weight of the ore, is expelled and the ore nodulized. The plant is capable of treating 5000 tons per day at an estimated cost of $1 per ton. The ore is apparently a secondary enrichment, the result of the decomposition of serpentine.

BOOKS REVIEWED

ORE MINING METHODS. — By Walter R. Crane. Cloth, octavo. 218 pages. Ill. New York: John Wiley & Sons; London: Chapman & Hall. Price 12s. 6d. For sale by *The Mining Magazine*.

The literature devoted to actual mining, that is, the systematic breaking of ore underground, is so scanty that any new book on the subject will be welcomed. This volume, by the professor of mining in the Pennsylvania State College, represents a serious effort to give a description of various methods in vogue in the United States. The sub-title states that the book comprises "descriptions of methods of support in extraction of ore, detailed descriptions of methods of stoping and mining in narrow and wide veins and bedded and massive deposits, including stull and square-set mining, filling and caving methods, open-cut work and a discussion of costs of stoping." This programme has been carried out with commendable faithfulness and the book therefore will prove a valuable addition to the progressive man's library. But it is open to several criticisms: the author avoids references and those that he makes are incomplete. He should acknowledge the descriptions given by others and he ought to add foot-notes embodying precise references to the literature of the subject. It is unscholarly to write as if no one had ever touched the subject previously. Many good articles have been written, but they are too scattered for ready use. Mr. Crane could have made better use of the information available. In the use of terms he is lax; why perpetuate so confusing a term as 'milling,' when applied to a method of mining; surely "a milling method of mining" makes for nonsense; locally it may be excusable, but that is no reason for introducing the usage into a textbook. We note that the Centre Star mine is Americanized into Center Star; this is an elementary blunder, for a proper name is spelled in one way only and that is the way chosen by the person or company to which it belongs. Mr. Crane does not seem to care for uniformity of style, spelling a mine with a capital or without, at haphazard; he abbreviates minutes into 'mins.' and seconds into 'secs.,' he uses unnecessary ciphers thus ($17.00 and $60.00); he appears to dislike hyphens, for he does not use them, even where they can be employed advantageously; he uses colloquialisms cheerfully. Why "square-set" but "arch pillar"; why "non-Bessemer ores"; or "subs" for 'sub-drifts'; or "raisers" for 'rises.' As Mr. Crane has contributed largely to technical literature and evidently intends to contribute more, it is a pity that he does not pay better attention to his method of literary expression. Nevertheless, even if he refuse to see the error of his ways, we shall not be so prejudiced as to refuse a good word for a useful book. 'Ore Mining Methods' could be much improved, but such as it is, it serves a want and fulfils a purpose. T. A. R.

THE VALUATION OF MINERAL PROPERTY. — By T. A. O'Donahue. Cloth. Octavo, 160 pages. London: Crosby Lockwood & Son. Price 7s. 6d. For sale by *The Mining Magazine*.

This book is intended primarily for use in valuing mineral estates for probate purposes and in connection with the new land taxes. We commend it because it gives more dependable methods of discounting deferred values at high rates of interest than those on which the usual tables are based.

This book has another use, which makes it applicable to the study of gold mining on a large scale. It enables an engineer to compare the relative profitableness of various ways of working well defined deposits. This subject was tackled by W. Fischer Wilkinson and W. H. Goodchild in papers read before the Institution of Mining and Metallurgy eighteen months ago, but it is doubtful if many engineers followed the arguments. To our own knowledge more than one authority on gold mine valuation dismissed a proposition as altogether too academic when mathematicians offered to instruct them in the art of estimating the relative present values when working proved gold gravels with larger or smaller equipments. As the present book explains these problems in detail, and treats all possible complications, it is eminently adapted for the pursuit of this study by such engineers as are interested. The author being a recognized authority on valuation, the book should become the standard.

TENT LIFE IN SIBERIA.—By George Kennan. Cloth, 8vo. Ill. 480 pages. New York and London: G. P. Putnam's Sons. Price 10s. 6d. For sale by *The Mining Magazine*.

In 1865 the Western Union Telegraph Co. sent an expedition to northeastern Siberia with the object of laying a telegraph wire that was to connect with the overland line through Alaska and British Columbia. With the exception of the crossing at Bering Strait this telegraph line was to be wholly on land and was planned to connect America with Europe. Among the explorers attracted by the venture was George Kennan, now known wherever English is spoken as the first of living reporters, using that term in its highest sense. He went with the expedition to Kamchatka and shared all its trials and tribulations in what was then a most remote corner of the world. Two years were spent in energetic exploration and earnest work on behalf of the telegraph company. Then came the news that the Atlantic cable was a success; the enterprise was abandoned, and Kennan returned, to enrich the world in 1870 with one of the best books of travel ever written. Owing to the continued demand for the book and the worn condition of the original plates, the publishers have issued a new and handsome edition, well illustrated and excellently printed. We recommend the book unreservedly; it is one that old and young can equally enjoy, for it is instinct with the perennial youth of manly adventure. I read it 15 years ago and recall the delightful impression produced. Kennan was not then the experienced traveller he has since become. He did not take for granted that his readers would know all about the little details that give vividness to a narrative; he did not write for blasé globe-trotters, but just told his story simply and vivaciously. It is a model book of its kind. Ever since I read it the flowery uplands of Kamchatka, the Chukchis and the Koraks, the dog-driving and the reindeer-sleighing, the barren steppes and the lonely mountains of northeastern Siberia have been a reality to me, no less than the indomitable courage, keen humour, and alert observation of the writer, who is now famous by his work at Martinique, on *The Outlook*, and on innumerable other occasions where the brass of journalism has been transmuted into the fine gold of literature. The present edition contains several new chapters, including an account of the incidents of a winter journey from the Okhotsk Sea to the Volga. It is illustrated from photographs and sketches. 'Tent Life in Siberia' is unique in many ways, not the least being re-publication 40 years after it appeared as the record of an episode that seemed a failure. It is true the telegraph wire lies rusting in the wilderness, but the communion of ideas has been quickened by George Kennan; he has joined Europe and America by bonds more enduring than copper wire. T. A. R.

CURRENT LITERATURE

Lead and Zinc in the Transvaal.—The *South African Mining Journal* for June 4 publishes an account by Messrs. Hall and Humphries on the geology of the Zeerust lead and zinc deposits.

Assay of Cyanide Solutions.—In the *Mining and Scientific Press* for June 11, T. P. Holt describes a variation in the method of determining the gold and silver in cyanide solutions. He discards zinc-dust and precipitates the precious metals along with the sponge-lead on a square of aluminium foil. The latter is a more effective precipitant in acid solution than zinc, and it replaces lead from solutions; thus the precipitated lead forms a convenient collector for the gold and silver.

Ely, Nevada.—The *Mining and Scientific Press* for June 11, gives a review of the present conditions of mining operations of the Nevada Consolidated at Ely, and describes the steam-shovel work.

Smelting Titaniferous Iron Ore.—In the April issue of the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa, G. H. Stanley continues his papers describing experiments in connection with the smelting of titaniferous iron ores.

Cyanide Accumulated Slime.—In the April *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa, John D. O'Hara contributes a paper describing his experience in treating old slime at the Nigel mine. The slime was of high content varying from 4 to 11 dwt.; the previous classification had been bad, so that the slime contained much sand; and vegetable growth had fouled the reservoir. The filter-presses provided did not answer except to clarify the solution after decantation.

Deflection of Diamond-Drill Bore-Holes.—In the *South African Mining Journal* for June 11, J. S. Curtis brings forward a theory to explain the deflection of diamond-drill bore-holes. He finds that drill-holes almost invariably turn to the north, and as the steel rods are known to become magnetic during use, he argues that the reaction between the magnetism of the rods and that of the earth tends to repel the bottoms of the rods from the south pole. In the northern hemisphere presumably the action would be reverse.

Converters with Basic Lining.—In the *Engineering and Mining Journal* for June 25, Redick R. Moore reviews at length the history of the basic lining of copper converters from the days of John Hollway and critically examines the claims of the Peirce-Smith converter used at the Baltmore works, described in the *Engineering and Mining Journal* for March 12. By reference to previous records of experience he fails to "see that Messrs. Peirce and Smith have invented anything," though he grants that they have advanced actual practice considerably.

Shaft-Sinking through Sand.—At the last meeting of the Institution of Mining Engineers, C. Pilkington and P. L. Wood described the sinking of a shaft in Lancashire by the Haniel & Lueg method using hydraulic power to force down the cutting edge of the tubbing. Similar work, but on a smaller scale, in Northumberland was described on p. 320 of our issue of December last.

Converter Practice.—With the issue of June 1 the *Australian Mining Standard* commences the publication of a series of articles by H. Schroder on Australian practice in converting copper matte. It may be noted here that converter plant is now being erected at Wallaroo, South Australia, and at Great Fitzroy, Queensland.

Goldfield, Nevada.—*Economic Geology* commences the publication in its June issue of F. L. Ransome's report on the geology and ore-deposits of the Goldfield district, Nevada. This is a condensation by the author of his voluminous report on the subject published by the United States Geological Survey.

Geology of Cananea.—In *Economic Geology* for June, S. F. Emmons contributes an extensive article on the geology of the Cananea copper district, Mexico.

Huelva Copper Deposits.—A. M. Finlayson commences in the June issue of *Economic Geology* a description of the geological features of the pyrite deposits of Huelva, Spain.

Economics of Mining.—In the *Mexican Mining Journal* for July, G. A. Denny writes on "What constitutes Profits," urging that allowances should be made for redemption of capital out of profits.

Accuracy in Sampling.—In the *Engineering and Mining Journal* for July 9, Louis D. Huntoon discusses the possible sources of error in mechanical samplers, especially in connection with the Jones riffle sampler.

Mining in Arizona.—In the *Engineering and Mining Journal* for July 16, Peter B. Scotland, mine superintendent for the Arizona Copper Co., gives an account of mining methods adopted at the mines of this company at Metcalf.

Origin of Ore Deposits.—In the July *Bulletin* of the American Institute of Mining Engineers, Charles R. Keyes contributes a review of opinions and collected information relating to the origin of ore deposits. In order of importance, he gives the ultimate sources of ore material as (1) meteoric accumulation, (2) lithologic decomposition, and (3) magmatic expulsion.

Mine Haulage.—In *Mines and Minerals* for July, Eugene B. Wilson continues his articles on the evolution of mine haulage, and discusses gravity inclines, aerial ropeways, belt and other conveyors.

Flue-Dust and Fume.—In the *Engineering and Mining Journal* for July 16, Lewis T. Wright gives his views and experiences relating to the settlement of flue-dust and fume.

Secondary Enrichment.—In the *Mining and Scientific Press* for July 16 and 23, A. M. Finlayson gives a general outline of the present views on the economic side of secondary enrichment.

Yerington Copper.—In the *Mining and Scientific Press* for July 2, J. A. Carpenter describes the Yerington copper district, 50 miles southeast of Reno, Nevada.

TRADE CATALOGUES

THE HUMBOLDT ENGINEERING WORKS CO., of Kalk, Cologne, Germany, notifies us of the establishment of an English subsidiary company, the British Humboldt Engineering Co., at Lloyd's Avenue, London, and send us lists relating to metallurgical plant of all sorts, concentrators, coal washers, transporting machinery, etc.

THE DINGS ELECTRO-MAGNETIC SEPARATOR CO., of Milwaukee, sends us a pamphlet describing the 'M M' separator, that is, the particular type of the machine of medium magnetic intensity and suited to the separation of pyrite and siderite from blende, and other similar purposes. The machine is successfully working at many places in the United States.

THE MOORE FILTER CO., New York, has issued an elaborate and beautifully illustrated pamphlet giving full information of the construction and operation of the filter.

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Scientia non habet inimicum nisi ignorantem.

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REVIEW OF MINING

INTRODUCTORY.—The persistent rain has proved too depressing for the most optimistic of underwriters, so that business has been extremely slack during August. Even had the skies been blue the exodus to the seaside and moor would have restricted activity within narrow channels. Rain and holidays together are enough to kill business in London except under the most extraordinary circumstances, as during the Kaffir boom of 1895. But the dominant feeling is cheerful, and September opens with larger share dealings, especially in Rhodesians and West Australians. No marked revival can be expected until the grouse and the partridges have been shot, the seashore abandoned, and the call of business once more permitted to suppress our national fondness for the open air. However, by the close of the current month the tide of commercial life in London will have turned and we expect to see lively times, for conditions generally are favourable. Political controversy is quieted for the moment, trade statistics are eloquent of expansion, and money for speculation is accumulating.

TRANSVAAL.—The Minister of the Interior has announced the decision of the Government to establish a mint at Pretoria.

The election of members to the first Parliament of United South Africa is absorbing attention and promises to conclude in an endorsement of the ministry led by General Botha. We hope that the opposition will be strong enough to bring out the best features of party government.

We are glad to draw attention to the constant advance in the value of the Transvaal's mineral yield apart from the output of gold, diamonds, and coal. The products classed officially as other minerals include copper, tin, magnesite, flint, asbestos, and graphite, the last two being of insignificant quantity. Aggregate yields have been valued as under:

Statistical year to June 30	Value of Output	Statistical year to June 30	Value of Output
1905	£43,728	1908.....	£218,926
1906	£88,435	1909.....	£321,724
1907	£147,875	1910.....	£539,150

During the last few months, the yield has exceeded £50,000 in value, with £58,728 in June. The coal output also indicates expansion, although there is no increase in the number of producing collieries. In June, a record tonnage of 487,572 tons was mined and 360,618 tons sold at 4s. 10d. per ton at pit's mouth.

Early in August activity was imparted to the Kaffir market by the Rand labour returns, indicating a smaller decline in July than a year ago. A net decrease of 3226 natives was announced as against 4057 in July 1909. The gold production for July of the current year aggregated £2,713,083, which is the highest on record, with the exception of December 1908, when the returns were swollen by transfers from the reserves of bullion. However, the output only indicates stability, not expansion, for the daily average of 20,604 oz. was slightly under that of June, when it was 20,839 oz. per day. For the first seven months of the year the yield was £18,270,421 as compared to £18,084,512 during the corresponding period last year. This is fairly satisfactory, having regard to the uncertain labour supply, and the Rand will be fortunate if in the critical months covering the seasonal Kaffir migration the mining industry is not seriously crippled, as was the case during the same period last year.

Our Johannesburg correspondent draws attention to the Transvaal Mining Commission and refers in a complimentary manner to the report recently published by that Commission. As regards Sunday labour, no reason has been

found for altering the legal definition of Sundays, Christmas day, and Good Friday, as days on which work is prohibited in mines for 24 hours from 6 o'clock in the morning to 6 o'clock of the next day. It is also considered that the class of work permitted on such days needs no alteration. As to hours of labour, it is proposed that no employee shall work for more than eight hours, exclusive of the time occupied in going and coming, save in cases of necessity or where permission is granted by the Government Mining Engineer. Several suggestive conclusions are enunciated, the most interesting of which is that "the labour employed on the Rand is admittedly inefficient, and that, therefore, the training of our miners is a question of national importance." It is recommended that the State provide a mine for training men and for supplying skilled workers, and, finally, the Commission advises the establishment of stations for testing explosions.

RHODESIA.—We note with pleasure that Mr. H. B. Maufe, formerly a member of the Scottish branch of the Geological Survey of Great Britain and later engaged as a geologist in British East Africa, has received an appointment from the Chartered Company as director of their geological survey. Mr. Maufe is on his way to Mashonaland and will begin work at once.

Early in August the announcement of an arrangement made between Rhodesian companies for a re-modelling of a Native Labour Bureau stimulated dealing in shares.

Later in the month a fillip was given to share-dealings by the rumours, subsequently confirmed, of a trust or combination of five mining companies. The idea is that such a consolidation would do for Rhodesia what the Consolidated Gold Fields has done for the Rand; it would furnish a good counter for gambling and create another sponsor for new undertakings. What is needed is more work underground and less stock-jobbing. Rhodesia wants ore, not share certificates. Official statistics show that the output of gold in July was only 46,367 oz., this being the lowest since February 1909. The number of productive mines remains 173. So far this year production is below that of the year preceding.

It is announced that the Eckstein group have taken an option on two miles of claims adjoining the Le Page, in the Abercorn district, and it is rumoured than the Cam & Motor claims are shortly to be floated in London. Good news has been cabled from the Globe & Phœnix, Selukwe Columbia, Wanderer, and Giant. Two new companies called the Rhodesia Esperanza and Don Proprietary have made their appearance and deserve to be commended for the moderation shown in their capitalization. If they are any good at all, the shareholders will have an excellent run for their money.

WEST AFRICA.—The rise in tin has drawn further attention to Nigeria as a source of this metal. We infer that active exploration is in hand, for we know that a large number of capable young engineers have been engaged during the last few months by various companies. The region is healthy for Europeans and the distribution of tin over wide areas has been ascertained beyond doubt, but, as usual, over-capitalization threatens to smother the commencement of a valuable industry. The enhancement of shares on the Exchange is a legitimate hope but it should follow, not precede, actual mining operations.

Substantial results are being obtained at the Nigerian tin mines; thus the Naraguta company announces that in the first six months of this year the output was 215 tons of black tin worth £21,500, yielding a profit of £10,000. This looks like business.

Recent underground work in the Cinnamon Bippo and the Wassaw mines has necessitated a revision of the estimated ore reserves. At the former the reserve on June 30 was 241,669 tons averaging 7·81 dwt., as compared with

208,809 tons on March 31 averaging 10·12 dwt., while at the latter the reserve has risen from 202,916 to 237,442 tons, but the average has fallen from 10·65 to 8·39 dwt. No ore is being extracted at present, as operations are centred on development. It will be seen on analysing the figures that the total gold content is less now than three months before. This is due to the orebodies being found to be much more broken than was at first supposed.

It is a disappointment to the Bibiani company that the Government has refused financial help for the construction of a branch railway from Dunkwa to the mine. The company will now have to build a haulage road, and not until it is completed will the additional heavier plant be erected. In the meantime the consulting engineers advise a continuance of developments on a large scale.

We have recorded during the last few months the gradual increases of the output at the Ashanti Goldfields as the new metallurgical plant gets to work. The output has suffered a temporary check, which is due solely to unusually heavy rain.

AUSTRALASIA. — The news from Western Australia is more cheerful than for a long time past. Three districts are attracting deserved attention on account of new discoveries, namely, Meekatharra, Southern Cross, and Youanme. The first of these is on the railway north to Nannine from Cue, in the Murchison goldfield. A number of claims have been pegged and a local excitement has been caused by the success of the Fenian and Ingliston mines. This district was first worked in 1898, but only became prominent in 1903. The leading mines have been fairly successful and recently have given evidence of enrichment on the lowest levels. The Oroya Exploration Co. has taken an option on a group of leases in this locality and has tested a lode to 160 ft., where the ore is as wide as 40 ft. and assays 1 oz. per ton, but the length of the orebody is yet to be ascertained.

Southern Cross or Yilgarn, as it was once called, is of course an old district, for it antedates Coolgardie. A new 'line of reef' has been uncovered called the Corinthian; on this lode two mines have been opened up: the Corinthian and the Corinthian North. In the latter a width of 30 ft. of 10 dwt. ore has been disclosed at the water-level (80 ft. below the surface). The outcrop is gold-bearing for a mile and has been sampled by mill-runs at the public battery. Another lode, the Bullfinch, is said to be giving 20 to 30 dwt. ore and promises well in depth.

Youanme is 40 miles south of the Black Range, half-way between Cue and Lawlers. The lode is of the same type as the Sons of Gwalia and the principal leases are under joint option to the Oroya Exploration and the Oroya Black Range companies. Workings to a depth of 200 ft. show an average of 14 dwt. ore for a variable width, from 3 to 26 ft. No mill has been erected as yet.

Altogether gold mining in Western Australia has taken a decided turn for the better. It will be remembered that the Black Range was the only dividend-paying mine brought forward in this State for 12 years, while the developments now chronicled are all to the credit of 12 months. From elsewhere also the news is good. The Sons of Gwalia has now opened up what is practically another mine on a new lode parallel to the old one. At Kalgoorlie the Lake View, in a winze from the 1900 ft. level, has found 1 oz. ore, this being the first find of profitable ore made in the bottom workings. Better still is the cablegram announcing that the diamond-drill in the Great Boulder has struck ore assaying 24 dwt. and 5 ft. wide at 2650 ft., which is the deepest level in the mine. The subsidence in the Golden Horseshoe is annoying, but it is not believed to be serious.

The Tasmania Gold Mining Co., one of John Taylor and Son's group, is to be reconstructed with an assessment of 2s. 6d. per share, whereby additional capital amounting

to £62,500 will be raised. The company, as recorded in detail in our February issue, was formed in 1903 to consolidate various gold mines in Tasmania that had become unprofitable owing to the great volume of water flowing into the deeper levels. After installing a gigantic pumping plant, the company produced large amounts of gold yearly, though without making any distributable profit. A year ago the average content fell, causing a loss on operations. As the orebodies are promising at depth, the directors now advise the raising of this additional capital to continue operations.

We refer to the Waihi elsewhere. The cablegram published on September 2 acknowledges that the decline in the grade of the ore necessitates a diminution of returns, from £74,000 in the four-week period to £68,000. This statement is unaccompanied by further explanation. For 1909 the Waihi paid dividends aggregating 18 shillings per share, but on the reduced output the dividends are hardly likely to exceed 16 shillings. This, of course, is not the worst aspect of the position, for the decreased production is a symptom either of an error in estimates or of an impoverishment of the lode in recent workings. An independent report is much needed. In the meantime we take pleasure in publishing a timely article on the silting problem by Mr. Arthur Jarman, professor in University College, Auckland.

INDIA.—The market in Indian shares has been somewhat upset by a fall in the price of Ooregums. The news from the mine gives no clue to the cause, for neither the output nor the ore reserve has declined in any way. Subsequently the price recovered, so the movement may be attributed to stock exchange influences, having no connection with the mine. The news from Mysore continues to be good; a new level in Ribblesdale's section is developing large amounts of high-grade ore.

KOREA.—Mining in Korea will not be affected by the annexation. The Korean Exploration Co., through the agency of W. P. Anderson, of Cincinnati, has acquired the Chiksan mine and will erect a large power plant, preparatory to dredge and mill the gold-bearing gravel and quartz on a concession covering 250 square miles situated 50 miles south of Seoul. The Oriental, Suan, and Kapsan mines are all doing well.

MEXICO.—It is stated that Mr. R. M. Raymond, for the Exploration Co., has taken an option on the holdings of Rickards & Clark at Sierra Jaurez, in Oaxaca. This is merely a working option, to test the ground preliminary to a more serious contract. The veins contain both gold and silver and the property contains several *antiguas* or old native workings. From Pachuca we learn that a company called the Santa Gertrudis (South) Ltd. has acquired several claims adjoining the big mine controlled by the Camp Bird company. Operations are being directed by Mr. M. H. Burnham, who is associated with Mr. John Hays Hammond. It is said that the present syndicate, with a capital of £40,000, is to sell its holdings for £500,000 to a new English company. Meanwhile the Santa Gertrudis mine itself is being most successfully operated by the Camp Bird company and the advisory engineer, Mr. W. J. Cox, states that the lack of power for machinery will shortly be obviated and that the developments in the bottom of the mine are most satisfactory. The 17th level has fully fulfilled expectations. The new mill of 600 tons daily capacity is to be ready in March.

CANADA.—An official report was received by the Canadian Geological Survey on July 29 from E. G. McConnell, who was commissioned to examine into the alleged discovery of a mountain of gold-bearing quartz on Bitter Creek, near Stewart, in the Portland Canal district of British Columbia. He states that while vein-matter is abundant, the gold content is so low that it is doubtful whether it can be extracted at a profit. The lodes are, however, promising enough to justify some expen-

diture in exploration. The mountain has not been thoroughly prospected, in fact, much of it could only be prospected with the aid of a balloon. The report indicates that the rush made by prospectors was not justified, though surface indications give encouragement to further prospecting. This confirms our view of the episode as expressed two months ago.

UNITED STATES.—Wall Street is gloomy. A succession of adverse influences have given the bears the upper hand, and stifled speculation on the part of the public. The check to gold importation, the reported injury to crops, the dwindling trade balance, the threatened readjustment of the tariff, and Mr. Roosevelt's speeches have all fallen like cold douches on the overheated imagination of financiers and promoters. Of course, Wall Street affects to disregard the speeches of the lion-hunting reformer, but undoubtedly the American people take them seriously and his campaign in the West is sure to cause trouble in "the financial district." Any tinkering with the tariff causes intense vibration throughout the industrial organism of the United States.

Our San Francisco correspondent refers to discoveries of gold-bearing gravel in the Iditarod district of Alaska. We learn that 'stampedes' to the Kobuk, Koyukuk, and Kuskokwim river valleys have enlivened the summer season, which is only too brief. On the Koyukuk one party of five men washed out $210,000 worth of gold. Undoubtedly all the cream has not been skimmed in Alaska.

The announcement of the customary dividends by the three companies operating on the Treadwell lode, in Alaska, is accompanied by satisfactory news concerning underground development. These mines are on Douglas island; on the mainland opposite is a group of promising low-grade gold lodes in schist, notably the Alaska-Perseverance and the Alaska-Juneau. Both of these have now surmounted the early troubles incidental to the exploitation of large bodies of poor ore and have reached the stage where the emphasis can be laid on the "large" rather than the "poor." Wernher, Beit & Co. and the Mein estate are interested in the latter, while the former is directed by Mr. Arthur L. Pearse, on behalf of the Alaska Consolidated.

Despite the devastation caused by forest fires, mining activity in the Northwest is expanding. In the Cœur d'Alene one or two new mines have begun to ship ore to the smelters and a large amount of real prospecting is in progress throughout Idaho, Montana, Oregon, and Washington. Gold and lead are being sought, rather than copper. Several old districts, such as Radersburg, in Montana, Elk City, in Idaho, and Republic, in Washington, are being resuscitated. Dredging for gold is proceeding at Ruby and Iron Mountain, in Montana, and at Pierce, Elk City, and Boise Basin, in Idaho.

The new goldfield of Jarbridge is giving promise of adding to the resources of Nevada. Some high-grade ore has been found, but the best prospects are on several large lodes that make a good showing at surface.

We regret to announce the demise of the Le Roi Mining Co., which is to be liquidated, on the advice of the consulting engineer, Mr. W. A. Carlyle. Mr. A. J. McMillan, the manager, becomes the liquidator. This is part of the vanishing heritage left by Whitaker Wright.

NICARAGUA is likely to be at peace shortly, for General Juan Estrada has driven the other two presidents, Zelaya and Madriz, out of the country. This is important to the Leonesa and other English and American companies operating in the tempestuous republic. Mr. Knox appears to have made a blunder by supporting Madriz, whom he subsequently abandoned. Meanwhile the Government of Nicaragua has met the payments due on her bonds and the financial credit of the country has been supported throughout the recent revolutions.

DREDGING.—The dredges of the Yukon

Gold Co., near Dawson, are doing excellent work, handling hard bedrock at a low cost. The technical success of these operations is most gratifying. The idea of dredging the Fraser river, in British Columbia, is again receiving serious consideration. A London company is preparing for dredging operations in Servia. Increased activity is reported from Rangoon, for mining in Burma has been stimulated by Australian purchases of both gold and tin properties, especially those suitable for dredging. The 8·5 cu. ft. dredge built for the Mewaing Gold No. 1 Ltd. by the Bucyrus company is expected to be in operation before the end of the current year.

OIL.—Apparently the position in California is not wholly satisfactory, for while production is expanding the market is restricted. Either an outlet must be sought in foreign countries easily accessible, such as South America, or the liquid fuel of California must be used in domestic manufacture. If continuity of supply be assured we see no reason why the manufacturing interests of the Pacific Coast should not avail themselves of the cheap fuel, the want of which hitherto has hindered the industrial development of California and Oregon.

As we go to press we learn that Well No. 79 of the American Oilfields Co. at Midway has started flowing again. Up to August 21 the official report showed a flow increasing to 25,000 bbl. per day, with a maximum at times up to 50,000. The output is now slightly in excess of that of the Lake View gusher, which is emitting 20,000 to 22,000 bbl. per day. Further, the No. 68 of the American Oilfields, only 1200 ft. northeast of No. 79 was 'brought in' on August 12 with 60,000 bbl., but it is yielding a great deal of sand and is expected to become a gusher.

Although Maikop is not receiving the daily notoriety of a new prospectus it is satisfactory to note that energetic work is in progress with a view to a fulfilment of the promises made by the many new companies issued in the spring. Some anxiety was caused by reports of antagonistic action on the part of the Russian Government, which was said to view with disfavour the acquisition of property by English syndicates, but this proved a canard. Recent exploration indicates that the productive portion of this oilfield, or, as our friends of the daily Press say, "the proved petroliferous area," is a belt not quite a mile wide and 15 miles long. Beyond the northern limit of this tract the oil stratum is too deep for economic results, for the Russian Geological Commission estimates the depth at 4000 ft. In regard to alarmist telegrams from St. Petersburg, Mr. George Tweedy is quoted as saying that the authorities are friendly to all but fraudulent enterprises. The pipe-line is to be ready for service in November; meanwhile oil is being stored, so that fully 60,000 tons will be on hand by the time the pipe-line is completed. A local association has been formed among the leading companies, with a view to concerted action in matters of common interest.

COPPER.—The American Producers' Association reports that the stocks on September 1 were 75,393 tons, against 76,180 tons in August, this being a decrease of only 787 tons. On the other hand production has increased from 52,843 tons in July to 57,055 tons in August. The total deliveries were 57,389 tons, as against 51,837 in the previous month. Obviously no signs of curtailment in production are visible and the position will become steadily worse unless consumption increases unexpectedly.

TIN.—A quite unexpected rise in the price of tin has taken place during the last few weeks. The price is fully £15 per ton higher than a month ago and stands at £165. In well-informed quarters there is an expectation of a further upward movement. The statistical position does not afford any explanation of the rise, which is due entirely to a bull party taking the opportunity to absorb the available three-months' warrants.

EDITORIAL

WE NOTE with pleasure that a series of lectures on economic geology is to be given by Mr. W. W. Watts during the next session of the Royal School of Mines ; the first portion of this course will be devoted especially to mining geology and is therefore of special interest to miners and metallurgists. Applications should be made to the Secretary of the Imperial College of Science & Technology, Exhibition Road, S.W. We give these particulars gladly, for if there is one subject more neglected than any other it is the economic geology as applied to mining. Mr. Watts is a professor of geology in the Royal School of Mines and fills worthily a chair formerly occupied by Murchison, Ramsay, and Judd. We hope that professional men resident in London or near-by will take advantage of the opportunity to obtain a post-graduate course of obvious utility.

KOREA is no more ; it is now a province of Japan and is officially christened Cho-sen. What the name signifies in Yokohama or Tokyo, we do not know, but we fear that the enquiring British schoolboy will be deluded into the belief that Chosen is the place of origin of a people prominent in finance and conspicuous in profitable enterprise all over the world. However, we may trust the Japanese to prove that they also know how to win profit out of the flowery peninsula, which at last has been annexed, thus fulfilling a destiny long obvious. We are pleased to note that, according to the Imperial rescript, the Emperor of Korea and the members of his House "will be accorded due and appropriate treatment." How statements do hinge on definitions ; we expect that the Japanese definition of "appropriate" differs slightly from that of the Korean. That is their affair, and it will not interest our readers as much as the question of the possible effect of the annexation upon foreign mining enterprise. On this matter we publish elsewhere an authoritative letter from Mr. H. Collbran. Japan conserves present interests by prolonging the life of existing tariffs and concessions for ten years. All treaties and contracts are respected for a decade, at least. As most of the mining enterprises were started during the period of Japanese dominance in Korea, it is not likely that any British or American company will suffer ; on the contrary, a more enlightened government ought to provide improved facilities.

THE TERCENTENARY of the discovery of Hudson's Bay has drawn attention to the vast region, illumined by romance and darkened by tragedy, that includes one of the few large tracts of land not yet explored thoroughly by the miner and prospector. The company in whom is vested the control of this continental area was given a charter by Charles II in 1670 and its first chairman was Prince Rupert, the Bavarian prince famous as a leader of cavalry. At first enriched by the business in furs and then by the sale of land, it has become one of the most important of modern organizations. As yet, however, the discovery of mineral deposits has not been a conspicuous feature in the history of the company, although several of the mining districts of Ontario are on land once included within its domain. Now, however, the construction of a railway from the Great Lakes to Hudson's Bay, in order to facilitate the export of grain, will also give ready access to a hinterland of undoubted promise to the miner. Northern Ontario, and even Alaska, were not believed to be countries for profitable mining until comparatively recently, and we shall be

surprised if the rapid development of the Canadian Northwest in agriculture is not followed by mineral exploration in localities now marked by blank spaces on the map.

FOREST FIRES have devastated the northwestern States of America to an unusual degree, despite the efforts of local volunteers and Government troops. About 150 lives are reported as lost and thousands are homeless. The mining communities in the Cœur d'Alene, notably Wallace, have been invaded by the flames and great injury has been done to the timber resources of a vast region. The event seems extraordinary to dwellers in London but it is nothing new to those who inhabit the forest-clad portions of Western America. Every summer, especially if marked by a long period of drought, is apt to end amid sporadic fires, of varying destructiveness. Some of these are of incendiary origin, others are due to carelessness. Prospectors forget to extinguish their camp-fires before moving forward and the wind scatters the hot ashes among the dry leaves or the inflammable grass. Moreover, an idea exists among miners that the clearing of the ground by fire is likely to facilitate the search for outcrops of mineral and for this reason the average prospector will look complacently at a forest on fire. Whatever the cause, the deforestation resulting has worked havoc to a great natural resource and it is part of the new policy of conservation to prevent such destruction, whether natural or artificial.

NEW YORK papers have given space to the exposure of a promoter who sold shares in a wild-cat mining scheme to a countess and to other members of the British nobility, not to mention sundry ministers, doctors, and widows. The swindler was arrested by the Post Office inspectors in his office at New York, entrenched behind half a ton of advertising 'literature,' including heart-to-heart talks on mining, glaring enticements to the untechnical, and clever allurements to the greedy. He put himself finally within the clutches of the law by making the specific statement that the ore was worth $20 per ton, which happened to be untrue. Thereupon he was charged with making a fraudulent use of the mails in connection with the sale of $3,000,000 of shares in the Gold Run Mining & Tunnel Co. of Boulder, Colorado. How eloquent a name! If anything could suggest a swindle it would be a Gold Run Mining & Tunnel Co. in the county of Boulder, Colorado. That district has been the incubator of wild-cats and the happy hunting-ground of abortive metallurgical processes for the last fifty years, that is, ever since gold was discovered in the Front range, whose snowclad crests look serenely upon the far flung prairies over which the pioneers made their toilsome pilgrimage from the Missouri river to the Rocky Mountains. We do not pretend to offer any sympathy to the titled lady or the untitled simpletons who were bamboozled by this New York promoter, but we do congratulate the American Post Office inspectors for one more successful effort to kill the parasites of mining and we offer the incident as a warning to our country-men.

RUMOUR from Portsmouth asserts that the next battleship to be laid down in that dockyard is to be furnished with internal combustion engines and is to discard steam and, with it, funnels. This may be premature, but it is significant of the trend of naval construction. Water-tube boilers and steam-turbines marked departures scarcely less radical. Experiments on motor-boats have proved that remarkable speed can be attained by aid of engines of internal combustion using petrol. Gas-engines and oil-engines have been tried successfully on gunboats and submarines, and now it is announced that a Hamburg firm is to build a cargo-steamer to be driven by Diesel oil-engines of 3000 horse-power. Most of the motors used for propelling boats use petrol

and its derivatives, all light oils, but heavy oils are less liable to the risk of explosion and it is likely that an effort will be made to use them. In any case, the prospect of an enormous extension in the use of oil is obvious; in fact, one of the objections to the adoption of oil as fuel for naval purposes has been the uncertainty of an adequate supply. Hence the experiments with gas producers that utilize inferior forms of coal. With the development of new oilfields of wide geographic distribution, the conditions favouring the use of internal combustion engines will become such as to warrant a departure of great moment not only to naval construction but to that branch of mining devoted to the search for oil.

THE BRITISH ASSOCIATION, in session at Sheffield, has discussed many burning questions but none of more practical importance than the misuse of coal in grates. The burning of bituminous coal in open fireplaces is an economic waste and an unmitigated nuisance, especially in a city like London. Valuable products of combustion are lost and the atmosphere is burdened with the coal-dust that escapes unburnt. No wonder the Londoner dwells under a pall of fog, seeing that he himself supplies the prime agency for making the murky mist overhead. The particles of coal induce the precipitation of moisture. For example, the building in which we write has several hundred rooms each provided with a wretched little grate in which a miserable quality of coal is half consumed, the other half being expelled into the air outside or into the room. Of course, a central furnace consuming the coal completely would afford more heat, more cheaply, and give the sun a chance to shine.

American Bureau of Mines.

Despatches from New York state that the President has appointed Mr. J. A. Holmes to be Director of the United States Bureau of Mines. The bill enacting the formation of this bureau was passed by Congress in May and public interest was aroused in the appointment of Director. Several mining engineers, including Mr. B. B. Lawrence, were mentioned for the post, but their lack of acquaintance with the coal industry was deemed a defect. On the other hand most of the coal specialists were ignorant of Western metal mining. Thus the choice eventually narrowed to two men prominent in the Government service and connected with the Geological Survey. Of these two Mr. E. W. Parker is known as the statistician at the head of the Division of Mineral Resources and Mr. J. A. Holmes as the chief of the Technologic Branch of the Geological Survey. Both are possessed of the diplomacy and *savoir faire* necessary to a public administrator in America—as elsewhere—and both possess a wide acquaintance with mining in every part of the United States. For reasons not necessary to discuss, the appointment of Mr. Holmes was most favoured in the West and by the general run of those engaged in mining, as voiced by the *Mining and Scientific Press*, of San Francisco, which 'plumped' for Mr. Holmes from the very first. Meanwhile the creation of the Bureau had, of course, aroused the jealousy of the Geological Survey, for it threatened to be a rival to that scientific corps, particularly in its extra-geological activities, which have so grown as to include many subjects quite foreign to geological enquiry. When therefore Mr. George Otis Smith, the Director of the Geological Survey, was appointed early in July as the Director pro tem. of the Bureau of Mines, a great deal of disgust was expressed at the indecisive action of the President and it looked as if the mining fraternity had been 'buncoed'—to quote a Western term used by our San Francisco contemporary. Hence Mr. Taft's change of heart comes now as a surprise and will gratify many of our readers. For Mr. Holmes

has earned promotion by his labours in behalf of mining technology and industrial betterment; he is thoroughly in touch with the manifold branches of a complex business; he is diplomatic without being insincere; he is energetic, but careful; he is *the* man for the post. We congratulate him and the Bureau, which now starts to work under good auspices.

United States Steel.

British comment on the operations of the United States Steel Corporation appears to have aroused American interest. Critics on this side object to lavish expenditure on plant resulting in capacity beyond any apparent prospective demand, all made at a time when markets are depressed, when labour costs are mounting, and barely 70% of the present capacity is being used. The great new plant at Gary, Indiana, has been built out of earnings and in all some $315,000,000 has been put into extensions and purchases in the nine years since the corporation was organized. While at the beginning the common stock admittedly represented nothing but water, it now has substantial value. If the money that has gone into new plant had been distributed as dividends the latter would have averaged 3⅜% better and doubtless the speculative value of the common stock would have stood higher, though the security of the whole enterprise might have suffered. In considering the policy that has been actually followed, account should be taken of two things. In the first place the steel industry now enjoys tariff favours that are not likely to continue, and in the second, the possibilities for increased local demand for iron and steel products far outrun anything a British manufacturer can anticipate. It may be granted that American steel-makers are not likely to take a large part of the foreign business until their cost of manufacture is revised, and it must also be recognized that there will be recurrent periods of poor demand. An instructive lesson may, however, be drawn from the history of American railways. In general they also started with a heavy load of common stock that represented water. In efforts to make a market for this to the advantage of the promoters, money was spent in dividends that should have gone to betterments. Many receiverships resulted and the strong roads of today, the Pennsylvania and the Chicago & Northwestern, for example, are the ones that consistently built for the future. Railway rates fell and it is inevitable that steel products must also come down. In short, the Steel Corporation, enjoying high prices, can now buy and build. Later the margin will not permit either, except as careful planning now leads to reduced costs. In the second place, there is no reason to anticipate any decrease in the growth of population or in the increasing consumption of steel. The providing of food for 150,000,000 to 200,000,000 people is no more real than is the necessity for manufacturing iron and steel products for the same population. California, for example, has about the area of France and can support approximately the same population, but at present is occupied by less than two and a half million people. What is true of California is equally true of other States. Great areas are still uncrossed by railways and great cities are yet to be built. We may think what we like of the relations of the United States Steel Corporation to tariff exactments, but it must be conceded that the business of the Corporation has been well managed.

The Square Fathom.

During the last few months we have referred at length several times to the new method of measuring outputs and profits at the mines of the Wernher-Beit-Eckstein group on the Rand, as proposed by Mr. H. F. Marriott, their consulting engineer in London. We have quoted Mr. Marriott and we have published critical letters and articles by mining engineers, some of whom know the Rand while others can claim wide experience elsewhere.

We desire to draw special attention to the paper by Mr. W. W. Mein read at the June meeting of the South African Association of Engineers and abstracted in our August issue, and to the letter in our present issue by Mr. H. S. Denny. Better authorities than these two engineers could not be found. They have been in control of underground work on the Rand and have thoroughly studied the economics of mining from both the practical and the scientific standpoint; but neither of them can see how the square fathom system will help.

Mr. Mein's contribution to the controversy contains many practical side-thrusts at Mr. Marriott's objection to the practice of milling low-grade ore, and he shows by concrete cases that profits may be increased by the inclusion of material of a content lower than the average cost of extraction. This at first sounds paradoxical, but it is, after all, the essence of the principle of working large bodies of ore with large plants. It must of course be remembered that the success or failure of the application of this principle depends entirely on the accuracy of the data upon which the calculations are based. That is why an imaginary case may lead us astray, and, in fact, why the principle cannot be applied unless the facts warrant. A case in point occurs in the recent report of the East Rand Proprietary where large bodies of ore are included in the reserve although their average content is less than the present cost of mining and indeed less than the figure to which even the most optimistic engineer can hope to see the average cost reduced. At first sight the inclusion of such ore seems quite unjustifiable, but judgment must be suspended until sufficient data are obtained to make it possible to apply Mr. Mein's method of argument.

Mr. Marriott's scheme appears to have been the product of two ideas, one being to simplify the reports placed before shareholders and the other to enable the mine manager to discard low-grade ore and hang up some of his stamps without alarming the shareholders. Probably the former is the ostensible reason and the latter the real one. Undoubtedly the average shareholder does not care much for the intricacies of tonnage and extraction. He prefers to know how big in extent rather than in content his mine is, how much of the productive area has been exhausted, and how much remains to prolong the life of the mine. A plan of the property with the three items of information relating to the areas of exhaustion, reserve, and probable ore, together with figures stating the profit per unit of area, will give the shareholder at a glance a far better idea of his investment than the complicated array of figures required by the mine manager. The shareholder cares little for stoping-widths and trusts to the engineer to get the biggest profit at the smallest outlay from any given area. Here comes the advantage from our supposed second point of view, for the stoping-width may be narrowed and the output reduced, without the shareholder knowing that a result of this policy is to use only part of the plant. The quarterly reports would say nothing about idle stamps, and an item of information that might naturally alarm the shareholder would be eliminated from the published statements.

Turning now to the effect of the new system on the mine manager's work, we can only join with Mr. Mein and Mr. Denny in being quite at sea as to the advantages offered, so we need not recapitulate their arguments. There is one point, however, in connection with the subject that deserves further comment, that is the apparently universal notion that the mines on the Rand are working a homogeneous deposit of uniform thickness and content. There was never a greater mistake, as the manager and his underground overseers know only too well. Regularity of output is usually attributed to an unvarying width and content, and engineers in other regions are inclined to

become jealous of the apparently unmerited reputation won by their confreres on the Rand. The fact is that the deposits vary within wide limits; in order to maintain a regular output a great number of working faces have to be chosen for simultaneous exploitation. To make this fact clear, it is only necessary to put the economic position conversely and ask, why, if the deposits are uniform, is it necessary to keep development so many years ahead of the mill? Of course, we know that it has only been possible to maintain a regular output on the Rand by conducting development on an extensive scale. The fact that the deposits are vast in their proportions tends to confuse our ideas on the subject, for here again the large scale of extraction is attributed not to the great area of profitable lode but to the supposed regularity of content. The number of productive lodes varies from place to place, and geologists have difficulty in correlating the seams of banket exposed in the different mines. Assays over any given cross-section of conglomerate vary from nothing to 4 oz. per ton, so that not only is it difficult to say how great a width is to be stoped but to average the value of the part stoped. Then again the content increases and decreases laterally and in depth in a fashion impossible to predict. Irregularity is intensified by faults and dikes, as in ordinary vein mining, and in some parts the formation is so broken that it is impossible to follow the ore. As already said, it is the extraordinary extent of the deposits that has made it possible to conduct gigantic development operations, which in their turn have made it possible to maintain great outputs of regular content. That the varying nature of the content makes it impossible to give an accurate assay of the ore stoped is confirmed by the practice of sending the output direct to the mill without any systematic sampling other than the monthly stope-valuation. Such daily sampling as is done is simply grab-sampling from ore cars, no automatic machinery having been installed for the purpose. In the metallurgical work the results are deduced from the recovery from mill-plates and cyanide plant, plus the assay of residue, as compared with the screen-assay; and the reliability of the figures expressing the extraction is admittedly open to argument. The suspected loss of gold—if we make a correct inference from the recent action of some of the Rand houses in engaging the service of the most experienced detectives—may not be as great as supposed, and may be due, in part, at least, to the absence of reliable automatic sampling of the mill-ore.

Enough has been said to show that in our opinion the ton of ore will still have to be the mine manager's unit, and that in no other way can the intricate details of content and cost be followed intelligently. However, we are still open to argument, and invite Mr. Marriott again to champion his scheme. He may wish to wait until the last of his critics has spoken, but if he waits until then he will face a public opinion strongly prejudiced against the adoption of his ideas. We hope he will reply forthwith.

Ferrobamba.

If the Ferrobamba deposit in Peru fulfils expectations, the world will be enriched by another important source of copper. More prospecting and development, of course, are needed before an accurate idea can be formed concerning the ultimate production from this deposit. The future of the Ferrobamba, indeed, is as undetermined as that of the Tanganyika Concessions, but as this enterprise has been started by giving ample and detailed information to shareholders and others, there is more opportunity for ascertaining the nature of the economic problem to be solved. Ferrobamba is in Peru, 40 miles due south of Cuzco or 75 miles therefrom by mule-track. Access is obtained from Mollendo on the coast by means of the railway to Lake Titicaca and

Cuzco. Before any extensive work can be undertaken railway communication must be made available either to Cuzco or to the coast, preferably the latter, for the distance would be much less than by the present roundabout route. The height above the sea is 13,000 ft., a disadvantage, of course, but not an overwhelming one, for at the famous Cerro de Pasco, which is even higher, Europeans and Americans in good health soon become accustomed to the low barometric pressure. The climate is mild and the snow-line is fully 600 ft. above the mines. The natives conduct their agricultural operations without trouble. From general indications the conditions are not nearly so adverse as they have been in other similar ventures. The ore is found as a contact metamorphic formation between an igneous rock and limestone. As regards the nature of the igneous rock, there are two distinct varieties, one granodiorite and the other described as either hornblende-biotite-granite or hornblende-biotite-andesite. The gangue consists of massive garnet formed from limestone by the heat and pressure of the igneous intrusion. The copper occurs as a sulphide, either bornite or chalcopyrite, which is distributed fairly evenly throughout the garnet, and the theory is that the copper was deposited from solutions during the metamorphosis of the limestone. The ore lies at the surface of the ground without overburden of any kind. The outcrop has been traced for nine miles and is as much as 3000 ft. wide. In places the outcrop is bold, in the form of bluffs that have been but little weathered. At some points the surface ore is carbonate but generally wherever the outcrop has been blasted by the prospector the sulphides are found unoxidized. Not much work has yet been done to prove the depth of the deposit. At one place a shaft has been sunk 100 ft., in ore all the way. At another point a tunnel for a powder magazine has been cut a few hundred feet, disclosing continuous ore. Keystone drills are now on the spot and a thorough test is to be undertaken. From extensive sampling on the surface, and in the limited amount of underground work already mentioned, the average assay of the ore in bulk is stated to be from 5 to 6% copper, 9 grains of gold, and 3 oz. silver per ton. High-grade ore was found in the shaft, along lines of fracture and due probably to secondary enrichment. On part of the property, known as Ferrobamba No. 1, where most of the development work has been done, the copper mineral is bornite and chalcopyrite; but in another portion, known as Charcas, massive pyrite is also found.

It would appear that direct smelting of the ore will have to be adopted, for as the garnet rock is heavy, having a specific gravity of nearly 4, water concentration will be impracticable. On the other hand, this rock is easily fusible and with the limestone of the district and the pyrite at Charcas the components of a docile furnace-charge are ready at hand. Fuel and transport present two difficulties. No fuel can be obtained locally and supplies will have to be transported from the coast. Fortunately water-power is plentiful in the neighbourhood, sufficient to generate current to meet all the requirements of the smelter and a railway; in fact, it is estimated that 100,000 h.p. could be obtained from this source. The only fuel required will be the coke for the smelting-furnace. There is naturally a temptation to think of electric smelting in a case like this, but it is obvious that a sufficiently low cost for current could not be obtained until a big power station had been built. The correct policy for the company to pursue is to build an ordinary blast-furnace, using imported coke until such time as the ore deposit is fully proved in extent and characteristics, and the metallurgical treatment determined. Large scale hydro-electric plant may follow later and also the application of current to the fusion of the charge. In this, our views coincide with the expressed intentions of the engineers associated with the enterprise. The mining of this great orebody

will be of the simplest, for it will be practically open quarrying with no overburden to remove. Altogether the Ferrobamba enterprise is interesting and promising, but not only does it require sagacity of management but, after the orebody is proved, the shareholders must be prepared to provide large sums of capital for power, railway, and smelting works.

Old and New.

During the past month the money markets have vibrated to the utterances of the two most remarkable men of our day—the Emperor William and Mr. Theodore Roosevelt. It is not the first time that the oratorical exercises of these gentlemen have caused disquiet, and it is fully appreciated that what they say signifies something more than rhetorical confectionery; therefore the speech delivered by the Kaiser at Koenigsberg depressed quotations on the Berlin bourse, and the commencement, at Utica, of Mr. Roosevelt's speech-making tour caused the gamblers on Wall Street to glance apprehensively from the ticker to the evening paper. Thus the stock exchanges of New York and Berlin were unpleasantly affected by these political utterances, and from their eddies of unrest the waves of perturbation spread to other money centres. Obviously, the worldwide community of interest in finance and commerce is such as to give international effect to a local event, if indeed the doings of such protagonists as the Kaiser and the ex-President can ever be labelled as merely provincial happenings. In this case assuredly they were deeply significant to others besides Germans and Americans. Also they offer a delicious contrast. It was medievalism that spoke at Koenigsberg and modernism that shouted at Utica. As we hear the head of the Hohenzollerns asserting his divine right to govern without regard to popular clamour we find ourselves in the museum of history gazing at an excavated anachronism. In England the divine right of Kings is associated chiefly with the untimely fate of Charles I; in America it is a mythological vagary akin to the belief in witches and alchemy. The exponent of Asiatic absolutism who sits on the throne of Frederick the Great is a curious survival of a bygone era and an impressive link with a dispensation long since dead as the dodo. In opposition to the threat of a medieval despot comes the plain talk of the great American tribune, who preaches a war on the corruption that is the canker at the core of American prosperity. He is 'out' against the 'crooks' whether they be among the rich or poor, in his own party or among those of the other side. Behind him will be the whole force of a public opinion that has been aroused by the revelations of municipal corruption in the big cities of the United States and by the exposure of political graft both in the Congress at Washington and in the legislatures of the individual States. The asseveration of the divine right of the Emperor of Germany may but inflame the antagonism of those who demand constitutional government, but the preaching of the virile reformer on the other side of the Atlantic is bound to affect the industrial development of a continent. It is for the American to show that he can industrialize his life without commercializing his soul.

Arsenic Fume.

In our last issue we referred briefly to the action in the County Court taken by a farmer against the South Crofty mine, in Cornwall, and recorded the fact that the jury had found that the deaths of the animals on the farm in question were due to the arsenical fume from the roasting-furnaces. As in all cases of this kind, the expert evidence was conflicting. The witnesses for the defence included a number of able technologists thoroughly acquainted with local conditions. Their view was that the capacity of the flues and the height of the chimney were sufficient to limit the amount of

arsenic escaping and to allow of its diffusion harmlessly. They could not believe that animals on the comparatively distant Brea farm contracted acute arsenical poisoning from the fume issuing at South Crofty. Other witnesses pointed out that the Tincroft roaster was nearer the farm than the alleged offender. Then the lawyers to whom is allowed the privilege of voicing current gossip suggested that as South Crofty was now making a profit, it was considered fair game by those thirsting for a lawsuit and the concomitant damages.

The usual explanation of arsenical poisoning in these cases is that the floating fume settles on the vegetation and so causes the death of animals grazing in the neighbourhood. One of the witnesses for the defence, Mr. C. M. Luxmore, broke new ground by declaring that under special circumstances arsenic existing as part of the earth's surface will become soluble and will be absorbed by the roots of a plant so as to enter into its texture. He proved by experiment that the vegetation tested by him showed the presence of much more arsenic when totally burned than when its surface was lixiviated. His theory is that when a plot of ground is left uncultivated and barren any arsenical compound such as mispickel contained in the subsoil will be weathered and rendered soluble, and by the upward movement of moisture due to evaporation from a bare surface will gradually be drawn into the top soil. It follows that any subsequent crop, when the land comes once more into cultivation, will be dangerous as fodder; also that while the land is still in a neglected state any casual growth should be avoided. To test this theory he visited the farm and discovered a neglected field to which animals could have access through broken hedges, and he attributed the death of the animals to their surreptitious browsing in this undesirable and uncultivated tract. Unfortunately the judge was not impressed with this opinion and the jury followed his lead. The general view of the case adopted by both judge and jury was as recorded by us last month, namely, that the South Crofty plant was not large enough for the increased output and that more fume had escaped than should be allowed. Nevertheless, Mr. Luxmore's views, though summarily dismissed by the Court, deserve some consideration. That his explanation may not have been the right one in this particular case does not necessarily imply that his theory in general is incorrect. Being an agricultural chemist of attainments his views on the physical and chemical conditions of soils are of interest. The judge, in commenting on the subject, said that it was incredible how arsenical ore should at this time of day be found near the surface in Cornwall, but any one acquainted with Cornish ore deposits will hardly endorse this expression of opinion. The whole question deserves more serious investigation and we urge Mr. Luxmore to elaborate his ideas and arguments, so that they may be fully sifted.

Mining in Cornwall.

Cornishmen cannot impute the local mining depression to the price of tin. At the ticketing held at Redruth on August 22 the high price of £105 was paid for black tin from the Golden Dagger, a mine near Tavistock, on the northern border of the county. It is a pity that, with black tin at over £100 and the metal quoted at £156 per ton, the profitable activities of the mines in Cornwall are represented by Dolcoath, South Crofty, and Wheal Kitty only, for these alone pay dividends to their shareholders. Opinions are divided as to the causes at the back of the present depression. Some there are who consider that the industry is on its last legs, simply because the mineral area has been exploited to the point of exhaustion. But this view is neither popular nor well founded. Cornwall is feeling the after-effects of the orgy of reckless finance that followed the boom of 1906. Tin was then quoted at £215, many companies were organ-

ized, large sums of capital were subscribed, and much money was spent in a spectacular way, only to stimulate speculation without making mines. A hole in the ground is not made into a mine by the erection of machinery, a mill, or a manager's residence; all such equipment has use, of course, but it must be adjusted to the search for ore and the profitable extraction of that ore. It is pitiful to hear the stories of mis-spent financial energy and to listen to the tales of incapacity linked to spoofery. After the brief spell of excitement in Cornish mining there supervened the inevitable reaction, so that of all the gilded schemes of the boom only South Crofty survives; for Dolcoath was a great mine long before the recent flurry, and after. And as long as the deepest mine in the Duchy is the richest the optimistic spirit of the miner will not despair of finding profitable ore elsewhere in this historic region. It may be that portions of the mineral area have been exhaustively explored, but we venture to suggest that it is cheaper to test untried ground than to reopen old mines. Moreover, it is wiser to consult men of provincial knowledge than to import experts ignorant of local conditions; and better still, to utilize the services of both, so that they may supplement each other, especially as regards the analysis of geological structure. Undoubtedly, in Cornwall, as elsewhere, money has been lost by reason of the cocksureness of those burdened with that little knowledge that is ever a dangerous thing. Yet even such eccentricities do not explain why less profit is being won with black tin at £100 than when it was sold at the ticketings for £75. One basic fact is the inefficiency of labour, for it is doubtful whether as much work is done today on an expenditure of £100 as was performed a decade earlier for £60. Not that wages are high, for relatively they are low; but the quality is poor, because of the continual emigration of the more intelligent and energetic of the mining population to America, to Australia, and to Africa. The younger mining regions have sucked the vitality of Cornwall, and what was left has been bled by a burdensome scheme of taxation, whereby local rates are piled upon the preposterous dues levied by the landlords. It is not a cheerful picture. Cornwall makes more money out of her beaches and cliffs, her diversified climate and rugged scenery, than from the exploitation of the tin ore that made her famous long before Cæsar landed in Britain. Meanwhile the skill and experience of Cornishmen are finding profitable opportunity in the search for tin in Bolivia, South Africa, and Nigeria. We shall yet hope that some of the resources successfully expended in foreign parts will be diverted to the 'old county,' as it has been in the case of Dolcoath, and that some of the men of local knowledge, enriched by worldwide experience, will see their way to re-vitalizing an industry that has fallen on evil days.

Applied Science.

In many quarters the labours and studies of the economic geologist are not yet fully appreciated. He is taunted, like most men whose aim it is to apply advanced science to engineering and mining problems, with being altogether too theoretical. Some even sneer at him, alleging that his sole vocation is to inspect other people's hard work and write voluminous reports couched in incomprehensible language; that he always comes after, and not before, the event of discovery; and that although his theories may give an explanation of each particular deposit they never help anyone to find new orebodies. It is not surprising that such sceptics should be numerous among the so-called practical, otherwise uneducated, miners and managers; but they are not confined to these circles, for men of high position in the mining and financial world assume the same attitude. Of course, the allegation that no direct practical result in the

way of a discovery of ore has ever followed the labours of an economic geologist can be disproved in a multitude of cases, but as a current example is better than any number of reminiscences, we content ourselves with drawing attention to the work of Mr. J. D. Millen at the Mount Bischoff tin mine, an account of which is given elsewhere in this issue. Five years ago this deposit was supposed to be near exhaustion. The appearance of pyrite discouraged extensive prospecting, for the old adage 'pyrite in, tin out' carried weight with the local practical miner. This was the chance for Mr. Millen, who was one of the scientific members of the staff. He was a keen petrologist and a believer in the theory that the tin was deposited from an upward flow of gaseous fluoride which had also topazized the felspar of the surrounding rock. Acting on the theory he microscopically examined the adjacent barren rock, and found crystals of topaz at various points not only in the diorite but in the slate. Thereupon he persuaded the company to prospect on the lines indicated by him, with the result that important orebodies were found. And not this only, for the talus of what was hitherto supposed to be barren rock was found to be tin-bearing. The fresh reserves created by the discovery of ore in the outer rock and in the talus are sufficient to keep the company going for years. Microscopical science has resuscitated a moribund mine. Its exponent has found his reward by being appointed manager. But does not he deserve more than this?

Waihi.

The weakness of Waihi shares has been the outstanding feature of New Zealand mining speculation. This decline in quotations has been in progress for several months and is becoming serious. We understand that the liquidation comes chiefly from New Zealand—a fact likely to increase the nervousness of British shareholders in a mine that ranks among the greatest of its kind. The information given by the management indicated merely a local variation in the width of rich ore at the deepest level, especially on the Martha lode, and anxiety was deprecated by reference to similar vicissitudes when the other levels were first driven. But this does not seem to be the real trouble. We publish an article on the silting problem. It is rumoured that the company is to be taxed by the Government for silting the Ohinemuri river with the tailing discharged from the mills and it is alleged that local holders are selling in order to meet financial obligations not connected with the Waihi. But these excuses do not ring true and leave the enquiring English shareholder in a darkness that can be felt. Undoubtedly the crisis would be worse if the personnel of the local management were not known to be both trustworthy and capable. Under these circumstances there is one obvious remedy, namely, to arrange for an inspection by an independent engineer. If nothing is wrong, then the expense, which is insignificant to a rich mine, is worth while if only to allay the fears of shareholders. It is the shareholders who will be paying for such a report. If developments are seriously unfavourable, the inspection of a competent man from the outside ought to be extremely useful both to the management and to the shareholders. It happens that Mr. W. Frank Grace is in the vicinity, he is connected with the adjoining mine, and knows the district well; therefore he is likely to interpret the position as favourably as the facts warrant. If so capable a man be not available, then it might be advisable to engage an engineer or mining geologist from among those resident at San Francisco, which is nearer than London. However, that is a detail; the point is clear: the reputation of a big enterprise is under a cloud and shareholders are worried by anxieties that should either be allayed or else frankly faced. Needless to say, this suggestion is made on our own initiative. The obvious needs no explanation.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

SAN FRANCISCO.

Stewart and the Portland Canal district have attracted much less attention here than in London. Indeed the accounts of the excitement into which you have been thrown by the reported discoveries are read here with some amusement. Possibly because we are nearer the scene we are more sceptical. As early as April trading in stocks of mines in the district was active at Vancouver and prices were inflated. The district has been examined at intervals by American and Canadian engineers, and that gold occurs is well established. The country rock is an argillaceous schist, cut by numerous dikes and sills. The veins in part are vertical fissures and in part are described as being bedded, though there may be doubt as to the latter. In the O.K., Little Wonder, and Stewart properties at Portland Canal, the veins contain pyrite, galena, blende, and occasionally native silver. The gangue is quartz with some calcite, and silver forms the chief element of value. On Glacier creek barite occurs in the gangue and the principal metallic minerals are galena, tetrahedrite, iron pyrite, and stibnite. Here again the principal value is in the silver, and some of the assays have shown over 2000 oz. per ton. On Salmon river gold as well as silver occurs. At Red Cliff near the mouth of American creek there are large mineralized zones containing chalcopyrite and pyrite. The area now has good transportation facilities and is easy of access. The larger veins so far found are of low grade, as is to be expected, but on the whole the conditions seem favourable for the development of a substantial mining industry.

OPEN-CUT ALLUVIAL MINING IN ALASKA.

In the meantime the rush is not unwelcome to the transportation interests and it is suspected that the accounts sent broadcast are in need of revision.

Iditarod reports are still confusing. That the area of rich ground is limited seems clear and that most of the ground worth staking was located last year by men armed with axes and numerous 'powers of attorney' is well established. More men have gone to the district than can find claims or work, and suffering is sure to follow. Many of those on the ground have taken 'lays' at high royalties from the land-grabbers who preceded them, but others, more determined, have spread out into the

surrounding territory and thorough prospecting of a large region will probably be one of the useful results of the stampede.

Oil.—Gushers continue to be found in California and owners are in doubt whether to classify them as assets or liabilities. The Lake View, for example, has cost fully $200,000 without as yet any cash return. A great quantity of oil, it is true, is held in storage against this expenditure, but stored oil decreases steadily in quality and quantity because of evaporation, while interest charges mount. Everyone now concedes that there is a temporary overproduction and the road to new markets is easier mentioned than built. Chile, it is said, could readily take 10,000 bbl. per day, and California would gladly spare that amount, but ships and tankage would cost $5,000,000 or more, and above all else time is necessary to develop the trade.

Meanwhile the gushers pour forth streams of oil that spread out into great ponds from which the summer sun laps up the lighter and more valuable volatile elements. None may stop production without fear of loss and, in case of wells on unpatented Government land, without risk to title. In the effort to assume that none but those engaged in genuine development should get title to land withdrawn, Congress provided that only those claimants should be recognized who were real occupants engaged "in diligent prosecution of work leading to discovery of oil and gas." All patents have been refused and no claimants dare stop drilling until the matter is settled. Additional wells are therefore to be expected. How important any of them may prove is indicated by the official report of well No. 79 of the American Oilfields. This well was 'brought in' last May at 1000 bbl. per day but increased to 3000 bbl. by July 25. From July 25 to August 4, except for one day when it 'sanded,' the well flowed from 8000 to 10,000 bbl. per day. On August 5 the rate in the forenoon was 20,000 bbl. and the average for the day 15,000. On August 6, 7, and 8, the average was 16,000, the flow reaching a maximum of 20,000 on the morning of August 8. The total yield from July 26 to August 8 was 143,200 bbl. On August 13 it was reported that sand had again interfered with the flow. Such wells upset all plans and while ultimately good use will be found for all the oil that California can produce, temporarily the market is congested.

Utah.—Consolidation of mining properties is constantly under discussion. The latest project to be broached is a merger on the Ontario, Daly West, and Daly-Judge at Park City. The proposal has much to commend it. The mine workings in this case follow a series of fault-fissures of which the Ontario-Daly is the greatest. This, to a depth of 1500 ft., is in limestone but below that lies the contact of limestone and quartzite. The ore is an intimate mixture of zinc and lead sulphides and the largest return has been derived from the silver content. The Ontario was one of the richest of the Hearst-Haggin mines and contributed millions to the two great fortunes associated with those names. The mines have been opened to a depth of 2600 ft. and were unwatered by an adit known as the Ontario drainage tunnel. This, becoming closed, was re-opened a few years ago by an interesting bit of work, a parallel entry being driven through some critical soft ground to relieve the timbers on the main adit. A contract has been let recently for a new drainage and transportation outlet to the Snake Creek Mining & Tunnel Co. It is to be 14,000 ft. long and will give access to the mines from the opposite side of the Wasatch range and will give entry to Daly-Judge territory 600 ft. below the present deepest adit. It is proposed to extend this and open other parts of the ground. Since the fall in silver, Park City mines have been operated on a narrower margin. By close attention and particularly by saving and dressing the zinc ore, profits have been won. The Grasselli Chemical Co. has a mill in the district in which, by close sizing and dry concentration, a merchantable product is made and ore from local mines also is treated by magnetic concentration. Many bitter law-suits have been waged over apex rights in Park City and consolidation of interest would be of large benefit. It is understood that one of the English houses is prepared to furnish working capital if the various owners can be brought together.

Comstock.—The merger of the Comstock mines, proposed last spring, has fallen through. New Yorkers apparently were ready to manage the property and to supply working capital, but had no serious intention of buying outstanding interests in the open market. On the other hand present stockholders were willing enough to sell but not to surrender their control except through sale. Little stock was deposited under the terms of the published agreement but so much was pressed for sale that prices broke badly. Seemingly the Californians have no use for Comstock shares if they are not to be allowed to gamble with them. However, holdings have been steadily accumulated by the more conservative owners and steady, though slow, progress is being made in

rehabilitation of the mines. The lower levels are being made accessible and such prospecting as has been done has resulted favourably. The Comstock may again come to the front even if no actual merger be accomplished.

TORONTO.

Porcupine is to have cheap electric power and an electric railway connecting it with the Temiskaming and North Ontario Railway as speedily as may be. The Provincial Government has granted permission to a syndicate of capitalists interested in the district to build the road, and survey parties are now at work laying out the route. The western terminus will be at Timmins Landing on the Metagami river, near the Timmins mine; the point of junction has not yet been decided. Two electric power enterprises are being undertaken. A. M. Bilsky, of Cobalt, and H. D. Symmes, Niagara Falls, Ontario, have secured the water power at Sandy Falls, Mountjoy township, and are making a preliminary survey with a view of developing about 4000 h.p. for transmission to Porcupine. The other scheme proposes to develop power at a point on the Metagami about 9 miles from Porcupine, where A. E. Walberg of the Mines Power Co. of Cobalt has obtained the right to develop power. It is estimated that from 6000 to 7000 h.p. can be generated at this point. It is hoped to have both these systems in operation by next June. At present development operations at the mines have been greatly curtailed, and in some cases entirely suspended owing to the difficulty of obtaining fuel, provisions, and other supplies. Wood is practically the only fuel available, and while sufficient for present requirements the supply will be altogether inadequate when the plants that have been ordered are in operation. At the Dome mine diamond drilling has resulted in striking a vein showing free gold having a depth of 100 ft. The Vipond, adjoining the Timmins property, has two veins which are being worked. One which has been opened up for 300 ft. shows free gold throughout and at 20 ft. depth has widened to 3 ft. The other is almost equally promising, assays showing uniform value.

THE PROSPECTOR AND HIS FRIENDS.

A geological map of the Porcupine gold area, prepared by Willet G. Miller, provincial geologist, on a scale of one mile to the inch, has been issued by the Ontario Bureau of Mines. It is accompanied by detailed maps of the principal properties and by explanatory notes in the nature of a report. Mr. Miller states that outcrops of quartz are numerous and are found in rocks of Keewatin and Huronian age. He has little doubt that the quartz

deposits are due to granite intrusions. The quartz has been deposited from the waters, which, while highly heated and under great pressure, worked through the rocks after the intrusion of the granite. A characteristic of nearly all the orebodies in the district is their variation in width from point to point. They widen into large masses, in one or two cases from 75 to 100 ft. in width, and then narrow abruptly. No sampling of the orebodies was undertaken but Mr. Miller states it could be seen from hand specimens that the quartz in several deposits was high-grade. Too much stress, he remarks, will not be laid by experienced mining men on surface values and they will wait to test the deposits at depth.

Gowganda is progressing slowly; in fact the general results from that district have been disappointing. Shipments this year to date amount only to 435 tons, of which 304 tons came from the Millerett mine. The Reeves-Dobie is erecting a concentrator. The Morrison mine was lately under option to a British company, but the deal fell through and it is now being worked by the owners. Good ore has been struck in a test pit 1000 ft. distant from the original discovery, and native bismuth is being taken out in considerable quantities.

Cobalt.—Though for some weeks mining stocks have been steadily falling, with an almost total want of interest on the part of the public, the record of actual mining operations has never been more satisfactory. The output shows the increase which was expected to result from the cheap power supplies and the adoption of more economical methods. The total shipments of ore and concentrate for the seven months ending July 31 were 17,980 tons, as compared with 17,651 tons for the corresponding seven months of 1909, but, as the number of concentrators has been doubled since last year, the increase in value is more noticeable. The tonnage sent out by the leading shippers during the seven months was as follows: La Rose, 3493 tons; Nipissing, 1948 tons; Kerr Lake, 3182 tons; Crown Reserve, 1948 tons; and McKinley-Darragh, 1013 tons. The ore sent out by Kerr Lake was largely low grade. The stock of this company has latterly depreciated considerably owing to the statement that its best veins are giving out and that present dividends cannot be maintained, but this is probably exaggerated for stock manipulation purposes. In addition to the shipments of ore and concentrate the output of silver bullion this year to date amounts to 353,963 oz. valued at $195,638.

Recent developments on the La Rose Consolidated properties have been of an encouraging character. A good orebody has been struck on the 135 ft. level of the Princess and two veins each about 3½ in. wide have been cut in exploration work on the 200 ft. level of the Fisher-Eplett. At the Nipissing, No. 64 vein shows a great improvement on the 270 ft. level, where it reaches a width of 2 ft. in places, carrying high grade ore. The Meyer vein also shows enrichment, yielding 8 in. of 3000 oz. ore on the second level. The Kendall vein, which has produced $2,200,000 during three years, is still a considerable factor of the output. It is being worked at the 225 ft. level just below the Keewatin contact. Crown Reserve is increasing its ore reserves. A rise on the new vein discovered 900 ft. down the lake from the former workings, shows good ore 80 ft. up from the 200 ft. level. Samples show 4300 oz. silver to the ton. This company, which has been shipping ore for two and a half years, has already paid 106% on its capital. The Temiskaming has sunk its main shaft to 520 ft. and has begun development work at the 500 ft. level. The development of veins No. 1, 2, and 4, on the 400 ft. level has resulted in finding high grade ore on No. 4 and a good showing of high grade ore on No. 1. The Provincial Government has made an important concession in the matter of royalties to the Temiskaming & Hudson Bay Co. They will allow $3·50 per ton for treatment charges on all low grade and concentrating ore passed through the mill, to be deducted from the 15% levied as royalty upon all ore mined. The Coniagas has resumed the payment of the regular quarterly 3% dividend. Veins No. 4 and 6, both carrying high grade ore, have been picked up on the 225 ft. level. The Chambers-Ferland has picked up the 'offshoot' on the third level 100 ft. from the shaft. It is quite narrow but rich assaying between 3000 and 4000 oz. to the ton. The Buffalo has declared an extra dividend of 3%. This brings its total dividend payments on $1,000,000 capital to $777,000. The Townsite, in which British capital is extensively invested, is improving. It has shipped two carloads of low grade ore this year and is planning to make regular shipments early this month.

Ore Stealing.—Two Poles were convicted at Cobalt of having ore illegally in their possession on August 3, and were sentenced one to nine and the other to six months imprisonment. The quantity of ore was small. The practice of high grading has been effectually checked by the new law.

JOHANNESBURG.

Transvaal Tin Mines.—The Zaaiplaats Reward claims, in the Waterberg district, continue to declare a steady output of high grade ore. 'Zaaiplaats' is commonly associated with the failure of the Government to establish thereon a profitable State tin mine, run by white labour, but this socialistic experiment was tried on only the Government portion of the farm. The Reward claims contain valuable deposits and were equipped early in 1909 with treatment plant including Blake crusher, 10 stamps (880 lb.), Wilfley tables, Frue vanners, buddles, and Buss slime-tables. At first 1200 tons were treated per month, carrying 8 to 10% black tin, and more recently the outputs have shown increased tonnage and reduced grade. The returns for May and June were as under:

	Tons crushed	Concentrate produced	Content of concentrate %
May	1530	100 tons	71·8
June.....	1501	100 tons	71·0

At Zaaiplaats, the tin occurs in pipes or chimneys in the granite, the deepest of which have been proved to retain their grade and form to several hundred feet. Two other notable tin producers in the Waterberg district are the Rooiberg Development company and the S.A. Tins (Dornhoek). The former works tin-bearing fissures in quartzite, and is now turning out 70 tons of concentrate per month containing 69% metallic tin; and the latter, operating comparatively low-grade fissures in shales, produces 20 to 30 tons per month containing a little over 50% metallic tin. During the quarter ended June 30, S. A. Tins crushed 2446 tons and produced 75 tons of 52% concentrates. Of the tin industry in the Waterberg district, of which high expectations were expressed three years ago, it can only be said that it is solid enough in a small way.

Brakpan Mines.—Although so many vertical shafts are being sunk to cut the 'reef' in the Far East Rand basin, the progress of results in the Brakpan mines is now followed with comparatively little interest. The eventual results at this mine are nevertheless of vital importance to this part of the Rand. The improvement in the value of 'reef' disclosures for the quarter ended June 30 is a matter for general satisfaction. The tonnage of ore "indicated by development" now stands at 1,222,600 tons containing 6·6 dwt. 'payable,' and 586,000 tons 'unpayable.' Of this total, the quarter's development alone was 315,877 tons at 7·5 dwt. and 157,144 tons of 'unpayable' at 2·7 dwt.

Village Main Reef Meeting. — The speech made by H. F. Marriott at the meeting of the Village Main Reef held in London, has been reproduced in the local papers and has given fresh life to a controversy that appeared to have died a natural death for sheer lack of opposition. It would be tedious to repeat the facts that render the fathomage scheme inapplicable in its proposed form. To quote one single argument raised at the Village Main Reef meeting, Mr. Marriott claimed: "The ore reserves are recorded in terms of the area within which they are included. That area has a distinct relation to the remaining claim area of the company's property." It need only be pointed out that the scheme calls

The Turf Shaft.

for the return of ore reserves on the basis of square fathoms on the plane of the 'reef,' for each reef. These reefs will be mined and developed in different ratios and the profitable proportions of each will be widely divergent. The definite relationship between this fathomage on reef and the intact horizontal area cannot be deduced by shareholders from the information provided in the returns and would require to be given as an estimate by the consulting engineer in exactly the same way that could now be done on the tonnage basis. Furthermore the information provided as to fathoms on reef, mined in a period, is liable to provide a deceptive criterion of life owing to the omission of the stope-width factor and consequently of information as to tonnage, through which unit the treatment capacity of the company must be expressed. The principal point missed by Mr. Marriott in the assertion made is simply that, although a mine has a definite claim area and a square fathom

is of definite limits, the number of inclined square fathoms to be stoped on all reefs is as indefinite as, and less capable of instructive expression than, the number of tons.

Sand-Filling Problems.—It only required Edgar Pam's brief paper on the progress of sand-filling operation on the Eckstein mines, read before the Chemical, Metallurgical & Mining Society, to start that open discussion so invaluable in the early development of technical processes. The sand-filling of old workings on the Rand is a new process, however long German or American mines may have done the same thing. Our problems are not theirs; our difficulties must be solved by original methods. The troubles do not lie in mere transportation of material from a point on surface to a point below. We have interesting chemical problems on surface, such as the destruction of cyanide in the current tailing; and we have also the more difficult mining problems due to the bad condition of the stopes into which it is desired to introduce the filling material. The Village Deep, into which C. B. Saner says 1200 tons of sand is passed per day, is a comparatively new mine, in which these difficulties may perhaps be less prominently in evidence. Because Messrs. Pam and Saner have wisely brought their limited experience to public notice, one manager has appeared inclined to sneer at them for considering themselves 'experts.' Such a captious attitude is to be severely condemned and is contrary to the spirit governing discussion in the local societies. The sand-filling process is novel and calls for extensive experimenting on the Rand. One day we shall know all about it. But its expansion as rapidly as possible is urgently desirable and any results of experience, even after a few weeks' work, cannot be made known too soon for the public good.

Randfontein Estates.—There has been a persistent renewal of rumours regarding changes of administration of the Randfontein Estates and for the third time in the last two years, the man-in-the-street has handed over the control to the Corner House and re-arranged directorates and managements in accordance with his "information on high authority." Johannesburg is not the place to seek reliable news of this description. The head office of the company is too far from Commissioner Street; the fountain head of all authority is in London.

The circular issued by the company in reply to attacks in London has done little to influence local opinions regarding the great corporation of the West Rand, in whose enormous possibilities the public faith has long been unshaken by administrative weaknesses. On the other hand, the great 600-stamp mill appears more brilliant to the mechanical than to the mining engineers. That the mines will be in a position to keep this colossal plant running at full capacity at the end of this year is generally doubted. The erection of a plant of such enormous initial capacity may prove to have been a mistake, but the intrinsic value of the properties is unquestionable. The Randfontein Estates is suffering from a need notorious in Rand mining circles. Its directors have every right to stand as industrial Jingoes and proclaim: "We have the ore, we have the plant, we have the money too!" They still lack one thing: they want the men. There is no mining group on the Rand in which there is less *esprit de corps* among its technical staff, less earnestness for the welfare of the mines, less inducement for the exertion of the best personal efforts, less promise of reward for good and faithful service. The mining man in need of work will seek employment with the Ecksteins, the Gold Fields, and the Farrar group, but the Randfontein Estates is his last resource; it provides only a temporary field for his labours until an opportunity for change appears.

Mining Regulations.—After three years of investigation the Commission appointed to enquire into Rand mining conditions, with a view to modifying old regulations or introducing new, has issued its report. It is a volume of about 400 pages and represents the outcome of well-directed and arduous labours, highly creditable to the small membership of the Commission. The health of the underground employee receives foremost attention. No question could be found of greater importance from the standpoint of State control and none could be more capably treated. Dr. Porter and A. Heymann have had long experience of mine conditions from the hygienic point of view, the former as medical man and the latter as chemist. F. E. T. Krause was the third member, who, though less known, proved himself serviceable to his expert associates. It is to be regretted that the mining or economic side was not represented by an authority, as it would have relieved the report of many recommendations that are merely academic in their significance.

Miner's phthisis and its prevention forms the basis of the most valuable part of the report. The commissioners give statistical data in evidence of the terrible effects of the scourge

and plead the necessity of reinforcing the regulations regarding the use of water in connection with all underground operations tending to raise dust. They also lay fresh emphasis on the demand for improved ventilation. No Government commission was required to enunciate the benefits of ventilation, for the practice is steadily growing. The East Rand Proprietary, Cinderella Deep, and Village Deep have experienced its advantages for a year or more. It was Mr. Heymann who five or six years ago created some commotion in technical circles by insisting that dust had been held responsible for too many evils, and that impure air was a factor under-rated by medical men.

Proposed Ventilation Regulations.—Government insistence upon proper ventilation gauged on the standard of so many cubic feet per man per minute (70 cu. ft. for the Transvaal) presents difficulties that are known to be almost insuperable. Such regulations only provide some definite figure with which the grossly neglectful can be brought to account. Quality tests alone provide a practical standard. Acting on this sound principle, the commissioners advocate certain regulations, giving the mine inspectors a far more stringent control over the provision of pure air underground. They wish to fix the legal maximum for noxious carbonic acid at 8 parts by volume in 10,000 of air, in addition to an allowance of 4 parts as representing the innocuous CO_2 normally present in the atmosphere, of 3 parts for the combustion of candles, and of 5 parts more for innocuous CO_2 from country rock and various sources, making a total maximum of 20 parts for 10,000. Samples for these tests, they recommend, shall be taken not less than one hour after blasting. The mines should be advised of the results of all official tests and prosecuted if, "after a reasonable interval following such notice," the requisite purity of air is not attained. It is the commissioners' view that chemical determinations should be made by the mines themselves once every three months of the CO_2 in the air, taken under normal working conditions from all drifts (100 ft. from face), winzes and rises (50 ft. from face), the bottom of upcast shafts, and stopes connected with only one drift.

New Milling Plants.—Whilst the huge Randfontein mill of 600 stamps and the City Deep plant, with its concrete king-posts, settling and treatment vats, are the most noteworthy erections in course of completion, the new battery of the Roodepoort United Main Reef embodies several progressive ideas. Simmer Deep principles have been freely adopted. The mill-building and bins are of steel and stamps of 1900 lb. are employed. The mortar-blocks are of reinforced concrete and each set of ten stamps has a separate line-shaft, operated by a 50 h.p. motor. Cam-shafts are of nickel steel. The mill comprises 100 stamps and five tube-mills, a high ratio that promises a monthly tonnage of well over 20,000 tons. It is to be hoped for the sake of a district that has been badly shaken by the Vogel Deep trouble that the Roodepoort United Main Reef can carry this additional plant successfully.

The Old Wemmer Mill.

Lower Witwatersrand.—Absentees from the Rand, acquainted with the history and geology of the district, may have read with some perplexity from time to time of the prospecting work undertaken on Austen's claims near Witpoortje, of the rich ore disclosed, and the reported sale of the claims for £37,000. They will recall Witpoortje, a mile to the north of the French Rand Gold Mining Co. in the West Rand, as a popular Saturday afternoon holiday resort of twenty years' standing, plentifully besprinkled with old bottles and sandwich papers. Yet it is nevertheless a fact that a surprising development has occurred in a member of the long neglected Government Reef series, underlying the Witpoortje railway station and outcropping a few hundred yards distant. Many hundred holiday makers must have crossed and noticed this banket bed every year; but the 'reef' had a poor reputation. Further to the west and east it had been widely prospected. On the Ruislip property, several miles west, what is apparently the same body has been unsuccessfully stoped and milled. Stretches of this Government Reef

have assayed 3 or 4 dwt. over a stope-width of 3 feet. Near Witpoortje the most promising band, under 12 in. wide, had not the reputation even for such a grade as this. Two years ago, however, Mr. Austen decided to sink on it and test it in depth. The exact results obtained have been kept secret, but it is unquestionable that a highly profitable zone was entered and that Mr. Austen has developed a promising little mine. Favourable reports on this prospect have been made by reputable engineers. The question of persistence is of prime importance. Experience of the 'reef' further west is against continuity; as also is the general result of exploration of veins in the Lower Witwatersrand formation below the Main Reef. But then experience was opposed to the opening up any such patch of ore as that actually disclosed today on this unlucky line of country. The poor results that have attended exploratory work on any deposits in the Witwatersrand formation underlying the Main Reef series have just been exemplified by the sale by auction of the property of the North Witwatersrand Gold Mines for £4800. This company was floated by the optimistic Count de Warv in 1904, with an authorized capital of £700,000.

DENVER.

Colorado. — 'What is the matter with Colorado?' has been asked with increasing frequency of late. So prominent a man as S. W. Eccles, vice president of the American Smelting & Refining Co., has been quoted as saying: "I am sorry to say that I believe that mining in Colorado has reached its height. The future of the State lies in agriculture." This naturally has created much comment and while many have objected vigorously to Mr. Eccles' diagnosis, there is a general opinion to the effect that mining is no longer the dominant industry in the Centennial State. Formerly when lessees and others made money in mining they put it back in the form of further development. Now, with increasing frequency, they buy chicken ranches or fruit farms. Irrigation and dry-farming have developed so rapidly that it is probably true that in the future agriculture will rank first among the industries of the State. It does not necessarily follow that mining itself has passed its zenith. There is much unexplored territory and at any time a wholly new district may be developed. Within a few weeks Brashear has, indeed, sprung up five miles west of Georgetown and a rush into the district is in progress. Meanwhile it cannot be doubted that important changes have been taking place in the mining and smelting industry. High-grade ore is rarer, absolutely as well as relatively, and the mills take an increasing proportion of the ore. The smelting situation was reviewed in *The Mining Magazine* November last. Since that date the Argo plant has been dismantled, and the Modern, after a short run, closed down. At Buena Vista a small 'new process' smelter has begun work. No satisfactory information regarding it has been made public. The Golden plant has been re-opened by the North American Smelter & Mines Co. and is treating pyrite ores from Clear Creek and Gilpin counties. Since, however, the company depends mainly on its own mines, smelter rates have not been greatly affected. Mine operators would like to see competition, but they continue none the less to patronize the American Smelting & Refining Co. Meanwhile mining stock speculation at Denver and at Colorado Springs is at a low ebb and money coming into the State for investment goes to other industries instead of being used to develop new mines.

It must not be thought that these changes have been accepted without question. The Denver Chamber of Commerce has appointed a committee with Franklin Guiterman as chairman, and it is carefully investigating the whole situation. The publicity bureau maintained by the Chamber has been temporarily abandoned, it being felt that study rather than noise was necessary at present. Another agency, which has been formed to promote the mining industry of the State, is a Colorado Chapter of the American Mining Congress which in a certain sense succeeds the Colorado Mine Operators Association. An excellent board of directors has been chosen including E. A Colburn, W. J. Cox, E. M. Delavergne, A. W. Warwick, John R. Wood, D. W. Brunton, John Dalzell, A. G. Brownlee, J. F. Callbreath, Philip Argall, and others. It is expected that subordinate district organizations will be built up. It is proposed to seriously consider the mining problems of the State, legislation, labour, railway rates, and similar matters, rather than to start a compaign of 'boosting' and 'booming.' This attitude is significant.

Colorado Output.—Much doubtless can be done to improve conditions, but in the meantime the mines are far from being as moribund as this congress of doctors might lead neighbours to suspect. The July output from Cripple Creek, Leadville, the San Juan, Clear Creek, and Gilpin counties is estimated at $2,000,000. The Cripple Creek production amounted to

$1,224,936, the Golden cycle mill leading with 24,250 tons worth $475,688. The smelters handled 3600 tons valued at $235,800. The Cresson Consolidated shipped 2000 tons from the new plant replacing the one burned three months ago. The most notable event of the month undoubtedly was the opening of the new mill of the Portland Gold Mining Co., situated near the mine on Battle Mountain and designed to treat ore too low in grade to stand shipment to Colorado City. The process is one of concentration followed by cyanidation. The only peculiarity in the treatment is the addition of a secret chemical to the slime-pulp going to the agitators. Owing to threatened patent litigation the company has not published details regarding this. The ore sent to this mill assays $2·40 per ton and it is stated that the net profit is 75c. per ton.

Gilpin county and its mines have been treated instructively and entertainingly by George E. Collins in lectures delivered at the Colorado School of Mines. Evidently Mr. Collins believes that in 'the Kingdom of Gilpin,' at least, many of the old ways brought over from Cornwall are still not to be improved. His paper is too long to be reproduced, but I cannot forbear at least one quotation. "Gilpin county is essentially a district of small mines and variable orebodies. It is true that the veins are persistent, but this is not true, as a rule, of the individual orebodies. It is undeniable that the output for two generations has been remarkably steady, but when we come to the individual mines, we find that few of them have been in operation continuously for more than eight or ten years at most. The largest producer today may be in borrasca or shut down altogether tomorrow. This is a basic condition of the district, not necessarily a result of want of foresight or bad methods. It is not enough to attribute it to the failure of the operator to develop ore reserves sufficient for continuous working. Doubtless this is a contributing factor, but in soft veins, the expense of keeping open a great extent of levels and rises may easily counterbalance the advantage of maintaining a steady output. Recent technical writings have brought home to our minds the fact that unworked ore reserves lock up a great deal of capital, the interest on which must ultimately be charged to the cost of extracting them. Mining engineers are engaged for the purpose of assisting the owners of mines in realizing the greatest possible profit. While it may or may not be good policy to spend money in the expectation of finding other orebodies, it is nearly always sound policy, when you have money in the ground, to get it out as soon as possible. Unlike the governments of Saxony, of Transylvania, or of Norway, we are not trying to eke out our mines for hundreds of years to provide stable employment for the population of a district. The characteristic ore occurrence in Gilpin county is a productive zone, usually of greater vertical than horizontal extension, in a fissure vein. In these zones the payable

The Anaconda Gold Vein at Cripple Creek.

ore is not uniform, but tends to occur in disconnected or partly interrupted bonanzas. In most cases these zones were productive at the surface, and are intermittently productive to great depths. This condition, coupled with the laws in force at the time the mines were originally located, and the local topography, has naturally resulted in the opening up of a great number of small mines close together, by means of independent shafts which, in many cases, have reached great depths, so that we have mines which are deeper than long.

At times they may be in bonanza, when they make a large production shipping to custom smelters and custom mills. At other times they are in poor ore; then they struggle along or shut down altogether, to be reopened later by some more hopeful or richer party."

SALT LAKE.

Copper.—The present outlook for copper production in Utah is one of temporary curtailment with a view to resumption on a larger scale in the not distant future. The Utah Copper Co. has closed its Copperton mill and is shipping about 20% less ore than formerly. The Yampa smelter has shut down and the mine is shipping about one-third of the former tonnage to the Garfield smelter. The Copperton mill is believed to be worn out and, in all probability, will not resume. During the first half of August the daily output of the Utah Copper was 13,104 tons in comparison with an output of approximately 16,000 tons, as maintained previously. No reduction in the force is contemplated but the company will give increased attention to development during the period of curtailment. The Yampa closed its smelter, which has been a success from a metallurgical point of view, on the first of August, finding it necessary to work the plant at a capacity of at least 700 tons per day in order to operate economically. This tonnage did not permit of selecting the ore and the average shipped was too low-grade. Under the new arrangement about 250 to 300 tons of selected ore will be shipped daily to Garfield. As the Yampa ore is similar to that of the Utah Con., which has recently been withdrawn from Garfield to be sent to Tooele, and is an excellent smelting ore, it is reasonable to assume that the Yampa has a favourable rate for treatment.

Park City.—The second quarterly report of the Daly West shows that receipts exceeded disbursements, including dividend of $54,000 by about $12,500. Developments on the lower levels have been disappointing, however, and the mill is not making the saving, especially of zinc, that was expected and announcement is made that production will be materially reduced until the mill is either remodelled or another one built at the mouth of the Ontario drain tunnel. Just what will be done has not been definitely decided. It is known that a merger of several of the larger Park City mines, including the Daly West, is being considered, but the announcement of terms in an Eastern financial journal was entirely premature. The Daly Judge, adjoining the Daly West, has unwatered its mine to the 1600 ft. level by means of a Starrett pump. This portion of the mine has been inaccessible for some time owing to a flood of water which came so suddenly that the miners were forced to run for their lives.

Tintic.—The Uncle Sam and the Beck Tunnel have become involved in an unfortunate lawsuit, the latter suing the former for $300,000 for illegal extraction of ore. Tintic geology is somewhat complex and there is a theory that the Uncle Sam apexes the Beck Tunnel. If this should be brought into the case another chapter may be added to the disastrous series of lawsuits that has cost the mines of this district so dearly.

New smelter.—Operations have commenced at the Tooele plant of the International Smelting & Refining Co. and within the next month or so the plant should be in full blast. The ore was started through the sampler on August 5 and on the 15th the first furnace was skimmed. For the present the tonnage of Utah Con. ore will not be as great as heretofore, but this will be brought up to normal by the time the plant is in full operation. The smelter was finished within the time allowed and the cost was kept within the appropriation assigned. The plant started without a hitch and has worked remarkably well. Two furnaces are now being fed on Utah Con. ore and three MacDougal furnaces are in operation. As to the future, the Utah Copper Co. is remodelling its two mills with the idea of treating 20,000 tons of ore per day as soon as the new Bingham-Garfield railroad is completed. This road is a subsidiary of the Utah Copper Co. The possibilities are that with an improvement in the price of copper the Yampa will resume at its former capacity. The Utah Con. contract with the International calls for a treatment of a maximum tonnage of 1200 tons daily, and, while it is understood that the present output of 800 tons will be maintained for the time being, it is reasonable to suppose that the maximum tonnage will be shipped when prices improve.

Colin McIntosh, manager of the Ohio Copper Co., has returned from a European trip with F. Augustus Heinze, and has made announcement that their efforts abroad to finance the company have been successful, at least to the point that the mill will be completed. The mill is built in two units, one of which is equipped and in operation. The building and machinery piers are ready and with the money in hand to complete the installation of machinery there should not be no delay in getting the entire plant in operation. The plant was de-

signed to treat 2000 to 2250 tons of ore but the one unit in operation recently treated 1800 tons in one day. During the month of July the mill treated 37,000 tons of ore which produced 1300 tons of concentrate containing slightly less than 30% copper. The extraction is 65%, but this will be increased when the ore from the lower levels is reached as that now going into the mill is not only low in grade but carries considerable carbonate, which does not concentrate well.

go to the Cerro de Pasco mines in Peru. The arrangement, as understood here, is that Mr. Channing will act in the capacity of consulting engineer and leave active work to a local superintendent.

Vanners.—The largest single order ever placed for vanners has been awarded the Galigher Machinery Co. of this city. The order calls for something over 1500 vanners of the Isbell type at a cost of approximately quarter of a million dollars. The Isbell van-

THE COPPER REGIONS OF NEVADA AND UTAH.

In its second quarterly report the Utah Copper Co. states that especial attention has been given to stripping the portion of the ground acquired from the Boston Consolidated, so that underground operations can be entirely suspended at an early date. Eighteen steam-shovels are in operation and two more have been ordered.

It is understood that J. B. Risque, general manager of the Utah Consolidated, who resigns September 1, will be succeeded by Roscoe H. Channing. Mr. Channing was formerly manager of this company, resigning to

ner is the invention of a former employee of the Utah Copper Co. and was developed in the Garfield mill. It has a suspended rubber belt but presents material differences from standard types, especially in the mounting.

Cyanide.—An item of interest comes from Bingham in the announcement that a 50-ton cyanide plant is to be erected at the Telegraph mine for the treatment of the gold and silver ores. Bingham has good surface values in the precious metals, the camp being worked for gold and silver alone in the early days, but attempts at cyaniding have invariably resulted

in failure. With the development of the cyanide process during recent years the proposed mill may be more successful than its predecessors. The Telegraph is owned by the United States Mining Co., but the mill is being built by the Utah Leasing Company.

Nevada.—Advices from a New York director of the Nevada Con. are that no reduction will be made in the dividend rate of $1·50 per share although production is to be reduced to 5,000,000 lbs. per month, a decrease of 1,000,000 lb. It is expected that the improvement of prices, expected to come with curtailment, will about balance the decrease in production.

The report of the Montgomery Shoshone for May, which has just been made public, shows a slight loss for the month, the second time during the year. The mine has been a disappointment to the stockholders, especially in the tonnage claimed, and considerable dissatisfaction is being expressed.

The grading on the Nevada Copper Belt Line has been completed as far as the site of the Mason Valley smelter and the track should be completed by the first of the month. One of the mines most interested in the commencement of operations at this plant is the Nevada Douglas which is reported to have a total of 600,000 tons blocked out awaiting the day when the new plant will be ready to treat it. This ore is a good smelting mixture which averages 5·4% copper.

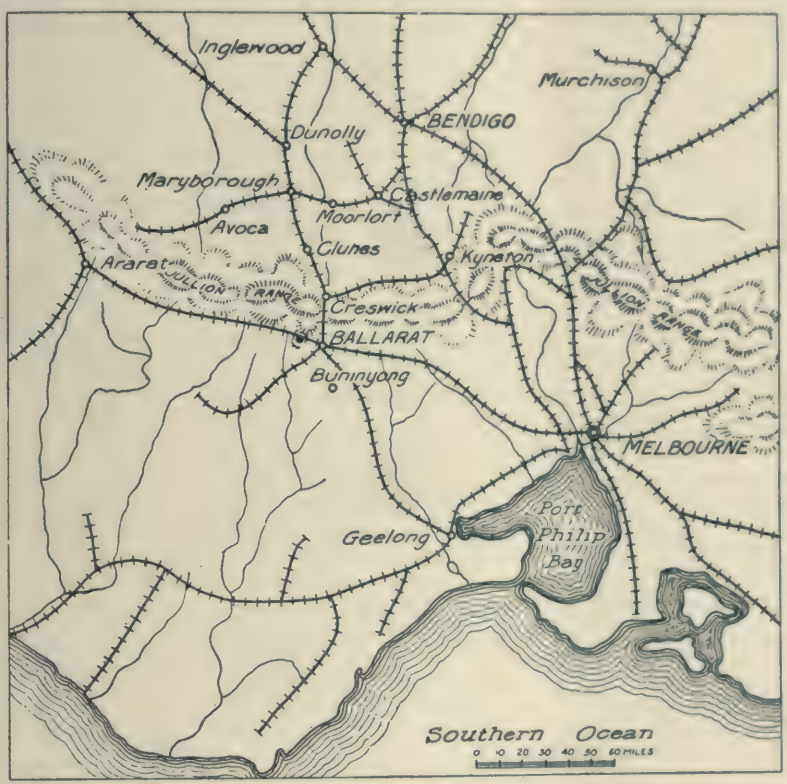
MELBOURNE.

The Bendigo gold yield for the first half of this year was the poorest since 1901. Dividends also fell away by nearly half as compared with the corresponding period last year. This was mainly attributable to the poorer results at the Virginia. For the first half in 1909, Virginia paid £26,323 in dividends, and only £2700 this year. Tributers' percentages enabled one or two companies to appear on the dividend list. Prospecting at Specimen Hill, Clarence United, Williams United, Johnson's Reef, Confidence Extended, United Ulster, Great Southern, New Red White & Blue, and Hustler's Reef, may lead to early developments. North New Moon is sinking for the Suffolk United reef, and a new company has been formed to work an old lease on the Sheepshead line called the Central Red White & Blue. The reason for this reduction in output is not far to seek. A close examination of the records of the mines at Bendigo shows that they were richest near the surface and then in a range of saddles between 100 and 2000 ft. Below 2000 ft. some good shoots of gold have been found but they have not vied in richness with the store in the upper levels. At present the Victoria Quartz mine with the aid of a Government grant of £10,000 is sinking 1000 ft. below 4000 ft. to test the orebodies at that horizon. This may mean much or it may mean nothing, because the prospecting that can be done from one shaft in a big district like Bendigo is comparatively limited. If luck should disclose a valuable deposit, the stimulus would be provided for other shafts to be deepened. Most of the mines at Bendigo are dry. At the Victoria Quartz, however, water is troublesome. The heat at a depth of 4500 ft. is great and makes short shifts imperative.

Mount Morgan.—The results of work for the first past year have not only been satisfactory but the outlook for the future is bright. The value of the output for the year ended May 31, was £1,079,914, obtained at a cost of £721,722, leaving a net profit of £358,192. This was won from 397,228 tons of ore so that the profit averaged slightly under 20s. per ton. On only one occasion previously has such a return been obtained. This was in 1890, just 20 years ago, when the mine was at its zenith as a gold producer. Then gold of the value of 1,066,705 was won at a cost of £205,288 and dividends aggregating £866,666 were paid. For the past year the dividend was £200,000. This shrinkage arises from the fact that the mine now relies as much on its copper output as on its gold. The oxidized ore has been exhausted. The chlorination of pyritic gold ore continues.

At the Mount Lyell mine work proceeds as smoothly as ever under the control of Mr. Sticht. News of the developments at the bottom of the North Lyell is meagre, but it is understood that the orebodies are opening out fairly satisfactorily. The company is doing prospecting in other districts. It is working hard on its leases at Mount Balfour and while the utmost reticence is observed respecting results obtained it is asserted that they are at least encouraging. This does not accord with the developments on the other mines in the district, which as a rule are far from satisfactory. The copper is found mostly in massive quartz formations and while surface indications are good nothing has been proved at depth. There seems to be a decided inclination on the part of the companies to wait on one another. This is not mining, and it is a pity that those who are shepherding claims cannot be jostled out by having the labour condition enforced.

Tanami.— Developments at the far-off Tanami field on the northwest desert territory of South Australia cannot be rapid because of the inhospitable and isolated nature of the locality. Still some samples of ferruginous felsite sent from one of the leases by the warden have yielded 14oz. of gold. The sample is said to be typical of the lease and the results are held by Mr. Gee (the warden) to be of "interest and importance." The wage ruling on the district is from £5 to £6 per week and the cost of dynamite is about five times as high as it is at Port Darwin. The Government of the State, however, is taking steps to improve communication and to provide a water-supply by well-sinking.



A Part of Victoria.

Great Fitzroy.—The position in respect to the Great Fitzroy mine, Queensland, is not at all satisfactory. The report by W. J. Loring, partner in Bewick, Moreing & Co., cuts down the ore reserve from 1,150,000 tons to 650,000 tons and somewhat reduces the average grade of the ore. The mill is to be scrapped, so to speak, and the order given to install a flotation plant. The trouble at the mill appears to have been in connection with the sampling. Of course, with all the gossip going about it is hard to get at the exact facts, especially as the people concerned do not want to talk about the past, preferring to interest themselves in the future. The heavy loss is understood to have been in the fine. When the method of sampling was altered according to Mr. Loring's ideas this loss was found out. It was also ascertained that the fine stuff from the mill fed into the furnaces was blown out by the blast. On working back from the tailing to the mill-ore a gap was detected and this put the investigators on the right trail. The net result has been a change in the management and a general re-organization of the staff. The returns are now better, but with copper at £55 the margin of profit and loss is small, and it is presumed that the idea is to save expenditure everywhere. The concern shown by some of the 'wise birds' in London has been most amusing to people on this side. They had an idea of how things were going, and the impression on this side is that the word 'scoot' went round. Here the gentle investor holds to his shares and trust to Bewick, Moreing & Co. to pull him through as they did with the Zinc Corporation. One unfortunate event in connection with the whole business is that D. P. Mitchell is understood to be resigning as mine superintendent. Indeed it is not quite certain whether he will continue in the service of Bewick, Moreing & Co. Much regret is felt at this, for Mr. Mitchell has done such sterling work on this side since he came here that he is regardedas a man of great ability. Therefore people in Melbourne will be most regretful if they should lose his services.

The Mount Maroomba flutter in the Northern Territory is at an end. Early reports by Andrew Wilson, the expert selected to visit the district to advise upon the prospects of the Mount Maroomba Prospecting

Co., which held the leading options on the field, seemed to indicate that there might be some hope. Later he gave the most emphatic condemnation and advised the company not to exercise its option. The pricking of the bubble brought shares that had stood at £185 down to £2 and incidentally killed all the pups that had been floated on the strength of the report of the original Mount Maroomba prospectors. The best of the transaction was that there never was any doubt in the minds of people who bought Maroomba shares that Mr. Wilson might condemn the field and that if he did the result would be a collapse. Apparently the outcrops are, as the prospector stated, huge in extent, but they seem to be diorite with occasional veinlets of galena. There is some limestone and in that too galena has been found.

Briseis.—David Currie, of Lake & Currie, of London, has turned up in Melbourne after having been in the East Indies, where he inspected an oil property for a London and Australian group. As soon as he got here he had to face criticism because the London directors of the Briseis, in Tasmania, to which his firm is the consulting engineer, were not disbursing profits and were chary about imparting information to the Australian shareholders. To understand the reason for this criticism the close attention given by Australians to mining has to be grasped. They are not content to accept the leisurely publication of news by a board of directors after it has filtered through the hands of consulting engineers. Sharp must be the word and quick the action. If news exists as to developments it has to be sent out immediately to the Stock Exchange or there are loud protests. The Stock Exchange often intervenes, and if it did not the speculator and the investor would want to know what it was about. Prior to Mr. Currie's last report on the Briseis mine, heavy selling was evident in our market. No one has hinted that Mr. Currie disclosed the nature of his report; still, orders came from London and were given locally for the quittance of stock. The investor on this side has not forgotten this fact, and as Mr. Currie is again visiting the mine, and as the directors' report is not to be issued until after he gives the board his present views, shareholders want a summary of his report cabled to London and published here simultaneously, and they want this done promptly. If not, no one would be surprised to see the local shareholders set to work to make some impression on the board.

Gold Outputs.—The returns for the half-year of the Bendigo (Victoria) and Charters Towers (Queensland) districts compare as follows:

	Value £	Dividend £	Calls £
Charters Towers...	341,450	57,695	26,435
Bendigo.....	304,192	43,300	58,394

These figures are somewhat misleading. The Charters Towers dividends come from a small number of mines, whereas the Bendigo disbursements are well distributed and none of them run into five figures. The difference in the calls also is remarkable. That arises from the profound belief of the average Victorian investor that you have only to stick to Bendigo and pay up calls, and other saddles will be cut underneath the upper ones, to recompense you for your outlay and your period of waiting.

Two interesting visitors to Australia are Messrs. Beer and Sondheimer, the big metal buying firm of Frankfurt, Germany. It is years since Mr. Sondheimer was in Australia and great changes have occurred since then. He and his partner came across America and as the Mount Lyall copper contract is just expiring and as the big zinc contract of the Broken Hill Proprietary Co. is also maturing the presence of these gentlemen may be explained, as they are the holders of the two contracts at the present time. The firm is most energetic and the question is whether their visit portends more than a mere looking up of old and profitable business connections. The Zinc Convention also is on the tapis and people would especially like to know what are the firm's views on the subject. But Mr. Sondheimer says "I hope for the best," smiles and stops at that. Loyal Australians would like to feel that the Broken Hill Proprietary or some other British concern had the handling of all our zinc smelting, but there does not appear to be much movement in that direction beyond the smelter being erected by the Broken Hill Proprietary Co. at Port Pirie.

MEXICO.

Pachuca.—Those who predicted that the consummation of the Santa Gertrudis deal would lead to a renewed activity in Mexican mining generally, and in the Pachuca district in particular, must feel flattered by the growing activity here. The Santa Gertrudis, La Blanca, San Rafael, and Real del Monte undertakings have served to prove the Pachuca district over a large area, and a careful study of the conditions disclosed in the development of these properties definitely proves the unmistakable existence of features which hitherto

have been associated only with the goldfields of South Africa. In fact wherever the bold policy of development practised on the Rand has been adopted in Pachuca it has met with notable success. In point of length of shoot, continuity of veins in depth, and evenness of mineral distribution there are features of marked similarity between the two districts ; whilst in regard to the width of orebodies, Pachuca, in its average of from 10 to 25 ft. possesses an enormous advantage. It is claimed that up to the present time there is not a single instance on record of a vein giving out in depth and certainly this claim is supported by the developments at any of the larger mines.

Pachuca is connected with three railroads and is only two hours from Mexico City. It has an established mining population, an abundance of electric power, a clean silver ore amenable to cyanide treatment and containing a fair percentage of gold. Its conditions generally from the industrial point of view are those of a well-ordered and thoroughly settled mining district. At the present time there is every indication that capital for the exploitation of new parts of this district is rapidly coming in, and already several development companies have started exploitation operations. It may be mentioned here that financial houses connected with South Africa are keeping their eyes on Pachuca and other parts of Mexico. Already one of the smaller houses has acquired interests and another more important one is intending to follow. In all probability I shall be able to make a public announcement in connection with this subject in my next letter.

The Santa Gertrudis is pushing ahead the construction of the new plant and the engineers have decided to include Pachuca vats and zinc-dust precipitation. Excellent progress is being made with the erection of the La Blanca plant and the Pachuca vat installation is practically completed. The whole equipment should be ready not later than January next. The Coscotitlan cyanide plant is now receiving a steady tonnage through the long pipe-line from the La Luz crushing station. Some 12,000 to 15,000 tons has already been transferred through this line, and Mr. Barker is to be congratulated on the success of his transmission scheme. The trend of Pachuca metallurgy is gradually narrowing down to an all-sliming, one-product, tube-mill, and filter-press scheme, and so far the results obtained leave little to be desired. The most debatable point is the class of filter best suited to this particular ore and there is some conflict of opinion as between the vacuum and pressure types.

CAMBORNE.

Dolcoath.—At the Dolcoath meeting R. Arthur Thomas gave some information in addition to that contained in the half-yearly report. The most important was that the current half-year's output would probably be less than the recent average owing to the dismantling of some of the old Cornish stamps, which are to be replaced by Holman air-cushion stamps. He described briefly the electrical plant now being installed at the new shaft and mentioned that the new pumps will only handle the water from the lowest levels, the pumps in Harriett's shaft being left to deal with the upper flows. The general impression given at the meeting was that, though the dividend has been passed for the first half of the present year and the output is being temporarily reduced, the situation will be greatly improved by next spring. Not only will the capacity of the dressing plant be increased, but the amount of ore raised will be greater and the cost of mining diminished.

Carn Brea & Tincroft.—The position of this old combination of mines between Camborne and Redruth is once more critical. Details are given in another part of the present issue, but briefly it may be stated that the company has arrived at a stage of its history when modern methods must be applied. It is usually said that the curse of Cornwall is the unsympathetic greediness of the owners of the mineral rights, and when we remember that the Tehidy estate exacted a ' fine ' or premium of £30,000 on the renewal of the Dolcoath lease some years ago, it is no wonder that bitter feelings exist in Cornwall. The Carn Brea & Tincroft company has two lords ; the Carn Brea belongs to the Tehidy estate and the Tincroft to Lord Clifden. The latter is more liberal to the tin mines than Mr. Basset of Tehidy. Probably he can afford to be so, seeing that he draws immense royalties from the more prosperous industry of china-clay in the St. Austell district. He has foregone his royalties at Carn Brea & Tincroft during the last 12 years to the extent of £15,000 and in addition has invested £12,000 cash in the purchase of shares. At the recent meeting of shareholders his agent, John Gilbert, who is his representative on the board of directors, spoke pretty plainly to those who wanted further favours from the ground landlord. In the first place he reminded shareholders that he had for years strenuously advocated the adoption of magnetic separation, for the reason that not only was a valuable material, wolfram, being lost as a source of income, but that its

presence in the tin concentrate caused the price obtained to be £5 to £10 less per ton than the better qualities sold at the ticketings. To prove his belief he announced that Lord Clifden would personally stand the expense of putting up a magnetic plant. Mr. Gilbert's other point was that the buying of plant and stores was conducted in an uneconomical way. This is a delicate question; briefly put, the manager has no free hand to buy materials in the cheapest market. Some interesting remarks were also made at the shareholders' meeting by James Wickett, the stockbroker of Redruth. He spoke plainly and said that the reason he preferred tin properties in the East Indies was that lords' dues and vested interests were not the controlling factors of the situation there as they are in Cornwall. It is clear however that in many cases lords' dues are only a red herring used to draw the attention of shareholders from the more real causes of failure to provide a dividend.

Wheal Grenville.—This company's report for the six months ending June 30, gives rise to the hope that in the not far distant future it will resume its place in the, at present, rather meagre list of Cornish mines earning profits. The loss for the past six months was only £136, although the reduction may be partly accounted for by lessened development which seems to be the favourite, but short-sighted policy favoured by some Cornish managers when losses are being made. The improved lode-values now being secured in the deepest levels should enable the new manager, Capt. Henry Battens, to turn the corner. There is one feature of the accounts which has given rise to a good deal of criticism, and rightly so. Although there is still £22,500 to call up on the partly-paid shares, the directors continue to borrow money from the company's bankers to finance the company. This was very well as a temporary expedient, but seeing this has now been going on for three years, and that the debit balance to profit and loss is now no less than £10,466, the time has surely come when a call should be made and the company put in funds, thus saving the interest now being paid.

Three Shift System.—Much discussion has been aroused by a writer in one of the local papers who recently made the statement that one of the reasons—perhaps the chief—why Cornish mining was in such a parlous condition at the present time was that only one shift was being worked underground per day in the majority of the mines, while the pumping and standing charges were going on all the time. He further stated that there would be a great increase in the output and consequent reduction in the working costs if the almost universal system of three shifts was adopted. Peter Watson in his speech to the Grenville shareholders the other day, touched on this question and advocated a conference of managers to discuss its possibilities. So far as Grenville is concerned, the plan is being put into operation, and will doubtless be watched with much interest. The same question was raised and discussed at the Carn Brea meeting.

Condurrow United. — The progress in unwatering this mine is not rapid, but now that the company has succeeded in raising new capital, it may be expected that the work will be vigorously prosecuted. Joseph Tamblyn, who is now the Manager, reports that the pitwork has been completed to the 205 fm. level. Below this, the underlie of the shaft changes from 60 to 48 degrees, so a turn in the main rods will be necessary unless the ground is blasted away.

Tresavean Mine.—This once rich copper mine situated at Lanner, near Redruth, is slowly but surely being drained, the water level being now 180 fm. below adit. The water is being held at this depth pending the installation of a new horizontal centrifugal pump at the 166 fm. level where a station has been cut large enough to hold two such pumps, and fitted with measuring boxes and tank to take the water from the sinking pump and 166 cross-cut. The lowest point reached by the previous owners, who endeavoured to unwater the mine in the eighties, has now been passed. Cornish pitwork has been found down to a little below the 166 fm. level.

East Pool Agar United.—For the quarter ending July 30, the loss incurred in working these mines was £152 which compares with £2029 for the previous 12 weeks. This reduction is not due to improvement in the content of the ore. Unfortunately most of it is explained by decreased development, the ratio to tonnage crushed being now 1 to 50 as against 1 to 40 the previous quarter. The expenditure for the 12 weeks under review was £13,998 or 17s. 1d. per ton, while the receipts amounted to £13,846 or 16s. 11d. per ton, showing a loss of £152 or 2d. per ton. The tonnage crushed was 16,369 and the development footage 327 ft. The recent discovery of the Great lode at the 255 fm. level in Wheal Agar continues to be the most important feature underground; the average produce from the lode for the quarter was 47 lb. of tin oxide and wolfram and 60 lb. of arsenic per ton.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

August 1910.	July 1910.	August 1909.
£55. 17s. 4d.	£54. 5s. 5d.	£59. 10s. 2d.

The copper market has been waiting for some official declaration regarding the agreement among producers to restrict output, and the fluctuations in prices though not so violent as those to which we have been accustomed lately have been frequent according as rumour has declared for or against the scheme. Otherwise circumstances have been largely in favour of holders. For the end of July the European figures showed the substantial decrease of 4718 tons in the visible supplies, the deliveries to consumers making a better showing than at any time for over two years and testifying to the great activity in European trade. The American stocks for the same period showed only 1000 tons increase which must be regarded as favourable. A study of the two sets of figures discloses a process of gradual shifting of the copper stocks from Europe to America. The total increase in the last seven months is only 3100 tons. The appearance of the producers' statement was followed by a cheerful sentiment which raised the three months price from £55. 12s. 6d. to £57. 5s. From this level a relapse occurred to £56 induced by unsettled American markets leading to a flood of realizations, but the inherent strength of the position is disclosed in the rapid recovery again to £57 when the sentiment changed at the end of the month.

Consumers in Europe continue busily occupied and are active purchasers of refined copper. It is difficult to make a correct estimate of the position on the other side of the Atlantic where rumour plays a more important part and industry is waiting to be assured as to the prospect of the crops before making fresh commitments. Sales however are reported of over 40,000 tons of electrolytic copper for home consumption and export, for delivery over September, October, and November. The price has risen from 12⅝ to 12¾ cents per lb. in New York and in Europe large lines have been placed at £58. 10s. Order books here and in Germany have probably never been so full and a good consumption is assured for some time to come. The greatest activity of course is in the electrical branches. The French Government has given out fresh orders for ammunition. India has been in the market for yellow metal. Sulphate of copper is also improving and good orders have been taken for wire and locomotive plates.

TIN.

Average prices of cash tin:

August 1910.	July 1910.	August 1909.
£155. 8s. 2d.	£149. 2s. 1d.	£135. 18s. 3d.

Tin has been a very interesting market. The leading bulls have been indulging in a bear squeeze. The metal stood at £149. 5s. for cash early in the month, with a contango of 22s. 6d. for 3 months; then the bulls, assisted by good American enquiry, locked up the available cash warrants and have rapidly established the price of cash tin at £166 with a backwardation of £5. Shorts have become thoroughly alarmed and supplies have been hurried forward from all available sources to London warehouses to obtain the advantage of the increased cash prices. Towards the end of the month the market became excited and prices fluctuated widely, frequently with a variation in the backwardation between £6 and £2. 5s. At times it was impossible to obtain quotations. The market is entirely at the mercy of the bulls.

Demand is good, the tin-plate trade is busy and makers are well booked ahead. The rise in price however is inevitably having an adverse influence on the industry.

LEAD.

Average prices of soft pig lead:

August 1910.	July 1910.	August 1909.
£12. 10s. 9d.	£12. 11s. 8d.	£12. 10s. 6d.

Lead has been steady, with quite a considerable business passing. Supplies on the market have been only moderate, to the considerable inconvenience of consumers, but prices have been unaffected by the scarcity.

SPELTER.

Average prices of spelter:

August 1910.	July 1910.	August 1909.
£22. 14s. 0d.	£22. 5s. 5d.	£22. 0s. 3d.

Consumers are well employed both in the galvanizing and zinc sheet industries; so much so that the Syndicate has after much hesitation raised the price of spelter 5s. per ton. A further rise seems inevitable if the demand continues on the present scale.

PERSONAL

H. FOSTER BAIN is a national delegate to the Mining Congress at Los Angeles.

SYDNEY H. BALL accompanied R. GILMAN BROWN to the Atbasar copper district of Siberia.

F. K. BORROW, for Pellew-Harvey & Co., has gone to the Frontino mine, in Colombia.

F. W. BRADLEY has returned to San Francisco from Alaska.

F. W. BRAUN, of Los Angeles, is at Berlin.

HENRY T. BRETT is returning to Bulawayo, after a short holiday in England.

R. GILMAN BROWN left London on August 26 for the Atbasar mines, in Siberia.

JOHN F. K. BROWN has been appointed manager of the Vaalbank colliery, in the Transvaal.

J. W. BRYANT, of the Tyee Copper Co., Vancouver Island, is at Truro.

W. A. CARLYLE has returned from Foldal, Norway, and has gone to Servia.

C. M. CARROLL has returned to Peru.

H. S. DENNY returns to Mexico on September 18.

W. R. FELDTMANN and J. N. JUSTICE sailed for West Africa on September 15.

F. C. FREY, manager of the Simmer Deep, has left for a holiday in the United States.

ANDRÉ P. GRIFFITHS is in Brazil.

JOHN HAYS HAMMOND is expected at St. Petersburg.

W. CHARLES HAND left for Northern Nigeria on September 14.

J. A. L. HENDERSON is in New Brunswick.

ROSS B. HOFFMANN did not go to Siberia. He is now at San Francisco.

J. D. HUBBARD, from Korea, is at New York.

PHILIP A. IVANOFF, manager of the Kyshtim mines, was in London during August.

ARTHUR W. JENKS is on his way to Argentina having been appointed resident manager for the Famatina Development Corporation.

H. FORBES JULIAN was in London, but returned to New York early in September.

NEWTON B. KNOX has returned from St. Petersburg.

A. F. KUEHN is examining mines near Omsk, in Siberia.

H. W. LAWS has been appointed general mining manager for the Niger Company in London and Nigeria.

W. S. LECKY is here from Montreal.

P. G. LIDNER, of New York, is in London.

W. J. LORING is expected in London from Australia about the end of October.

ALFRED F. MAIN, resident manager of the El Oro and Mexico mines, at El Oro, Mexico, is in London to attend the annual meetings.

H. S. MULLIKEN, of the Peñoles mines, at Mapimi, Mexico, is at New York.

E. H. NUTTER has returned from Australia to London.

FRANK OLDFIELD is consulting engineer of the Bolanos mines, in Jalisco, Mexico.

J. C. PICKERING is temporarily in charge of the Mexico mine at El Oro.

C. W. PURINGTON is returning to London from Eastern Siberia.

EDGAR RICKARD sails for New York on September 25 and will be there two weeks.

A. L. SIMON, on his return from Russia, has gone to Porcupine, Ontario.

S. J. SPEAK is in Sumatra.

C. H. STEWART, of Alex. Hill & Stewart, is at St. Petersburg.

W. F. A. THOMAE has returned from the East Indies.

W. R. THOMAS has gone to Sydney, to inspect mines in New South Wales.

E. C. THURSTON is now at the London office of the Consolidated Gold Fields.

W. H. TREWARTHA-JAMES, manager for the Tyee Copper Co., was lately at Ketchikan, Alaska.

G. A. TROYE returns to Johannesburg on September 17.

H. W. TURNER is in Korea.

J. B. TYRRELL sailed on September 10, returning to Toronto.

E. C. VIGEON is at Salisbury, in Rhodesia.

W. FISCHER WILKINSON has returned from the Trans-Baikal region of Siberia and has gone to Cornwall, preparatory to assuming his new duties as Principal of the Consolidated Schools of Mining, at Camborne.

HORACE V. WINCHELL attended the International Geological Congress at Stockholm.

SILTING AT WAIHI

By ARTHUR JARMAN.

FOR the last four years farmers near Paeroa have complained of damage caused by the floods that leave deposits of fine silt, alleged to be tailing discharged into the Ohinemuri by the mines of the district.

The accompanying map shows the rivers and the sites of the principal mills. The Ohinemuri has a watershed of approximately 90,000 acres and the Upper Waihou has a watershed of 280,000 acres. Most of the timber has been cut on the Ohinemuri and much of that on the Waihou also. The rainfall is heavy (83·5 in. at Waihi) and it is by no means uncommon for 4 or 5 inches of rain to fall in 24 hours. Floods are therefore inevitable. From Waikino, where the largest mill is situated, to the junction with the Waihou, the Ohinemuri falls 205 ft. in a distance of 12 miles, but from the junction to the Thames estuary, a further 26 miles, the fall is only 8 ft. Hence the chief trouble has occurred on the low-lying country along the lower Waihou and on land round Paeroa, a township of 2000 inhabitants, where the chief industry is dairy-farming. The farmers stated that the silt was washed into their pasturage and that fine material remained on the blades of grass and leaves of herbs; this, being eaten by cattle, accumulated in the stomach as balls of silt, killing calves, and proving harmful to larger animals, notably milch-cows.

Nobody took samples of this fine material at the time of the flood, so no definite decision could be made as to what percentage of such deposits was due to mine tailing pure and simple. The farmers' association and the mining companies presented the results of grading tests of samples taken from the bed and banks of the Waihou river. These results showed that the tailing was not being carried up the Upper Waihou by the tide in sufficient amount to block the river, as asserted, the ebb tide keeping the river clear except near the junction. Evidence as to the silting of the river as a navigable channel was of a conflicting nature. The Ohinemuri and Lower Waihou were officially declared as 'sludge channels' for mine tailing in 1895 and in accordance with the Mining Act notice was given for 90 days to allow objectors to claim compensation if they supposed their land would be affected. No objections were lodged and therefore the farmers have no legal redress against the mining companies or the Government. Hence the recent agitation and the appointment of

WAIHI, NEW ZEALAND.

the Ohinemuri Silting Commission, which was instructed to take evidence on the matter in all its bearings and to consider "what, if any, remedial measures might be adopted without injury to any other persons, corporations, or interests."

The output of the mines of the district is fairly regular and may be conveniently gauged by the June returns. The position of the various plants is indicated by index numbers on the map.

From this we see that 49,000 tons of fine sand and slime are discharged into the river every month. Assuming 24 working days per month, the above output is equivalent to 85 tons per hour. The flow of the Ohinemuri was estimated at 150 cu. ft. per second just above the junction, or 18,000 tons per hour. In flood-time it is much greater. There was an exceptionally severe rain last March when 14 in. fell at Waihi in 14 hours and the flood flow of the Ohinemuri was then estimated to be 12,000 cu. ft. per second or 1,350,000 tons per hour.

During the enquiry a suggestion was made that the batteries should cease discharging tailing during floods. The figures show that the proportion of silt to water is normally 1 in 200 and at the time of the flood mentioned only 1 in 16,000. Clearly the damage due to silt would not be minimized by stopping the mills. The Commission therefore had to consider whether (*a*) to clean the river and improve it as a sludge-channel or (*b*) revoke the proclamation of the river as a sludge-channel. The witnesses that proposed the latter course were asked for alternative schemes for disposing of material all of which passes a 120-mesh sieve and much of which is a great deal finer. The rainfall at Waihi last year was 104 in., and the difficulty in stacking or impounding the above material in such a rainy district discounted most of the schemes proposed. The following ideas were suggested:

(1) Stacking or impounding on Rotokohu swamps;
(2) Disposal on Waihi beach: (*a*) transport by railway, (*b*) transport by pumping;
(3) Dam the river and remove the tailing by dredging or otherwise immediately above the dam;
(4) Clear the river from snags, cut down the willows on the banks, and dredge the watercourse;
(5) Also erect stopbanks where the banks are low.
(6) Dredge a cut to shorten the course of the Ohinemuri between Paeroa railway and the junction of the rivers.
(7) Assist by capital the Paeroa Gold Extraction Co., engaged in re-treating river tailing.

Index Number	Company	Stamps	Tube-Mills	June Returns	
				Tons	Bullion
1	Waihi Grand Junction	40	8	6,300	£10,909
2	Waihi Mill	90	3		
3	Union Mill — Waihi G.M. Co.	40	1	37,503	74,476
5	Victoria Mill	200	10		
4	Paeroa Gold Extraction Co. ...	—	2	Returns not	published
6	Talisman Consolidated	60	3 in course of erection	3,880	18,642
7	N. Z. Crown Mines	40	—	1,555	4,075
8	Komata Reefs	40	3	—	—

After preliminary sittings in Auckland, the Commission spent several days inspecting the river and mines, and then took evidence as to the damage done at Paeroa, the place chiefly affected by the floods.

(1) The proposal to stack or impound at Rotokohu swamp would necessitate 6 miles of railway or piping from Waikino, the nearest mill, and the material would have to be kept in place by retaining walls or dams of some kind, otherwise the heavy rainfall would cause some of it to find its way back to the river lower down. With any scheme involving trucking, a plant would be needed to empty the trucks, as the material packs and will not fall out when the trucks are turned upside down. If conveyed by piping, an impounding dam would be required with a long spillway to so reduce the velocity of overflow as to give good settlement. No estimates of costs were prepared.

(2) Disposal at Waihi beach; this place is a pleasure resort of Waihi people and there are also mining claims that would have to be avoided. Twelve miles of railway would be needed from Waikino to Waihi beach and some tunnelling through the hills between Waihi and the beach. A rough estimate was made of £166,820 capital expenditure and an annual expenditure of £73,443, or 2s. 5d. per ton on 666,000 tons per annum. This estimate includes all charges, depreciation, etc.; it appears excessive, but was made at a few hours notice by one of the engineers and was not challenged by those who proposed the scheme. Pumping the material across the hills, 300 ft. above the level of Waihi, was

deemed impracticable, as break-downs would be frequent and costs high.

(3) The impracticability of this scheme is evident from the flow of the river.

(4) (5) and (6) were generally favoured and will probably be adopted.

(6) The cut suggested would be from a point a quarter of a mile below the Paeroa railway bridge to the other end of the bend near the junction, thus shortening the course nearly 3 miles. This would relieve Paeroa township considerably during floods, but it was recognized that the cut would be useless unless the river-bed was first cleaned as suggested. Under the Mining Act the mines pay a duty of 2s. per oz. of gold produced and after deducting the expense of collecting the duty, the Government hands the money to the Borough Council in whose district the mine is situated, the idea being to assist in defraying the expenses of rapidly growing mining townships. The Waihi Borough received £20,473 in 1909 from this source alone, £1,750 from mining rents and only £1,085 in general rates; truly a remarkable income for a town of 6000 inhabitants.

An interesting situation developed when remedial measures were discussed. The Waihi Borough Council's representatives considered that the cost of remedies should be borne by the Government and that no part of the gold duty should be diverted from them. This meant, of course, that the general taxpayer would have to bear the cost, a suggestion foredoomed to failure. The mining companies objected to any additional expense in dealing with tailing, pointing out that the life of each mine and hence the work available for the miners would depend upon the tonnage of ore that could be won profitably, and any increase of cost reduces the tonnage available.

The Ohinemuri River Silting Committee did not see why their land should be spoiled even though no objections had been made to the declaration of the sludge channels originally, and contended that they should not have to bear the cost of the remedy. Their advisory engineer suggested proposals (4), (5), and (6), and that the work should be managed by a River Board, the initial expenditure being £8000 and the annual expenditure £4000, which it was suggested should come out of the gold duty. The Ohinemuri County Council only benefits to a small extent from gold duty and supported the farmers' suggestion. The mining companies favoured (4), (5), and (6) also.

The Paeroa Gold Extraction Co. owned tailing in claims extending 9 miles along the river. The tonnage was estimated at 2,000,000, containing 10s. 6d. per ton, of which 10s. could be profitably extracted by dredging, tube-milling, and cyanidation. Their plant had treated 33,000 tons already and at 500 tons per day they had 14 years of work assured. The manner in which the tonnage was estimated was not explained. Their work tended to clear the river by grinding the sand finely so that it would be more readily transported when returned to the sludge-channel. They strongly objected to a second cut in the river, as it would interfere with their tailing.

The fact that this company has worked several years upon river tailing is an eloquent testimony to recent advances in metallurgy and the concentrating power of a swift river, but the proposal that the Government should advance further capital was not regarded seriously by most of those present. Little evidence was available upon the carrying powers of rivers. A velocity of 0·5 ft. per sec. is said to be sufficient to cause fine sand to roll along a river-bed, and experiments were cited dealing with flow in launders (see *Engineering and Mining Journal*, September 21, 1907) showing that clayey matter and slime greatly increased the carrying power of the water.

Lower Waihou is a tidal river and silting occurs at high tide, but the velocity of the river at low tide is 1·5 ft. per sec., enough to preserve a good channel. W. F. Grace said that 95% of the material from the Grand Junction mine would pass a 200-mesh sieve. The Waihi company's material all passes 120-mesh. The size of aperture of the screens used in the tests was not stated. The Talisman Co. is installing 3 tube-mills and will soon discharge similarly fine material. The Crown Mines has no tube-mills; their plant had only recently resumed work.

Evidence was not taken on oath, but so many interests were involved that six legal gentlemen were constantly engaged in the proceedings. The chairman of the Commission was W. Ferguson formerly engineer to the Wellington Harbour Board, and the other members were C. R. Vickerman, of the Public Works Department, E. Mitchelson, formerly chairman of the Auckland Harbour Board, and F. R. Flatman, farmer of Geraldine, Canterbury. The report of the Committee has been presented but not yet published. It is understood in the parliamentary lobbies that the report recommends that the river be cleared and that the cost be defrayed by a portion of the gold duty.

MOUNT BISCHOFF

By F. H. BATHURST.

MOUNT BISCHOFF, in Tasmania, the greatest tin mine in the world, was not discovered without effort. Thirty-eight years ago this mountain, like its neighbour Mount Lyell, stood a splendid peak above a dense forest of myrtles, eucalyptus, and ferns. So barren and unprepossessing was it that the surveyors of the Van Diemen's Land Co. did not care to include it in their grant of Crown lands. They used the crest of it as a trigonometrical station, without the least idea of the wealth underneath their feet. The whole of the country then was virgin; the primeval forest everywhere. Creeks and rivers had no course outlined by a massive growth of vegetation, such as is the case in Australia, for they had cut their way deeply during past ages, until they splashed and tumbled far below the upland above which Mount Bischoff towers. The weathering of the basalt on the south and west slopes resulted in a deposit of the richest chocolate soil. Over this vast forest an undergrowth as dense as that of the tropics had spread. Today at Mount Bischoff most of that growth has disappeared, but a few miles back the bush is as dark, as forbidding, and nearly as impenetrable as ever.

From this maze comes the call of the bush. It is as real to the Tasmanian prospector as the voice of the sea to the mariner. Age and decrepitude never subdue the desire of the man who has once forced his way into the forest fastnesses of Tasmania to go back thither to make a bid for fortune and the reward it brings. This fact has to be realized to grasp the spirit that led the discoverer of Mount Bischoff to break into the bush year after year until he had reached the prize that his confident soul told him was hidden there. This man, 'Philosopher' Smith, has a record comparable to that of the intrepid explorers who from time to time made their way from the shores of the Australian mainland into the inland desert.

The north-west of Tasmania rises abruptly from the sea and is covered with immense flows of basalt, the evidence of a former period of intense volcanic activity. Rivers and creeks innumerable have worn their way through this rock so that even if the valleys and mountain slopes were bare of vegetation, the physical effort of exploring so rugged a region would be great. When tracks have to be cut through miles of bush to ensure the slightest progress; when, in addition, the country is swept by rain and snow in winter and is reeking with wet even in mid-summer, some of the difficulties faced by Smith can be appreciated. Once in the bush, man has to fight for life. No large supplies of food could be carried, as everything had to be packed on the back. What little animal life existed it was almost impossible to snare or catch. No wonder that Smith again and again had to retreat exhausted. A few months' rest to recuperate, and he was ready again. By some he was regarded as a madman; others, however, recognized his intrepidity and helped him in his quest. To one of these he at last came in the early 'seventies bringing with him a bag of specimens. Privation had worn him to a shadow, his clothes were in rags, and his condition pitiable. But he wanted neither food nor drink till the specimens were placed in a forge and melted. This was done. The bits of ore yielded a button of tin and Smith was able to realize that his life's work had been crowned by a great discovery. What was his reward? The Mount Bischoff mine since 1878 has distributed over £2,000,000 in dividends, but the discoverer died a poor man. That is often the fate of the pioneer. It was largely due to temperament. The bargain Smith made with the company formed to work the deposit was by no means bad. For his part, he offered for sale mineral leases in an inaccessible part of Tasmania. On the other hand, the capitalist had to open a way to the claims through the primeval forest, cut tracks, and test the mine. For what Smith had to offer he obtained 4400 shares of £5 each, and £1500 in cash. He also secured a seat on the board of directors and the right to appoint a nominee so long as he held 1000 shares in the company. As only 12,000 shares were issued, he obtained a fair proportion of interest. If he had held on to his shares he would have commanded more than one-third of total dividends of £2,000,000, apart from the market value of his scrip. Of course, neither he nor any of the original shareholders would have sold their shares had they realized the potentialities of the mine. Smith, however, soon disagreed with his co-directors as to the management of the mine and after they had installed H. W. Ferd. Kayser in con-

trol he sold most of his shares. The board did right in selecting Mr. Kayser. He developed the property and soon made it richly productive, a position it has retained to this day, having just declared its 394th dividend. The amount of the dividend has varied from time to time. During the high prices established by the French corner in tin in 1888 a distribution of 30s. per share was made every three weeks; now the lower grade of the ore restricts the dividend to 5s. per share paid monthly. The directors throughout have been thrifty and hold £30,000 in cash as a reserve against contingencies.

The crest of Mount Bischoff rises 500 ft. above the basalt, which touches its north-western slope. The flow of basalt extends south and east toward Mt. Pearce and the Murchison ranges. Across this plateau flows the Waratah river. About a mile from Mount Bischoff itself the river has cut through the hard basalt into soft rock until it drops 600 ft. almost precipitously. Water was thus obtainable for power, and a good site for the plant was available. The result is that the mill buildings are ranged, tier above tier, along the old waterfall of the Waratah river. Everything can be done by gravitation. In the old days huge water-wheels were used to generate power; these have been replaced by a hydro-electric plant which not only furnishes power for the mill but also for the transport of the ore, for lighting purposes, and for use in the workshops.

The early reports of the company show that the directors did not take long to realize that they possessed a 'bonanza,' but the initial difficulties were vast. The cost of carting was £10 per ton either way and even now it amounts to £3 per ton of tin concentrate from the mine to the sea-board. While it was then difficult to get the ore down to the sea, it was ten times more difficult to drag machinery to the claim. At last the Van Diemen's Land Co. built a railway to the district and the transport troubles were overcome for all time. However, in noting how dividends were affected by the early cost of transport, it is manifest why so many of the original holders sold out when they saw a fair profit in sight. At the start the mine was developed slowly, the delay being due in part to the troubles arising from the isolation of the district and also from the lack of knowledge how best to exploit the deposit. The first manager was W. M. Crosby, who took charge in 1873, the mine having been discovered in 1872, and the company formed in 1873. The capital consisted of 12,000 shares at £5, of which, as stated, 4400 fully paid went to Smith, leaving 7600 shares to be issued at 15s. each. Only two calls were made, of 2s. 6d. each. At an early date the directors proposed to call up £2 more per share, but they were enabled to finance the company without taking that step. On a working capital of £1520 the company has paid £2,000,000 in dividends. What a record! It is a remarkable fact, considering the value then attaching to the opinions of the 'practical miner,' that when the first difficulties arose over the working of the mine, the directors decided to call a scientist to their aid. This was G. H. F. Ulrich, of the Geological Survey of Victoria, a man of high attainments. After his visit Mr. Kayser was installed in command, in 1875, and he soon began to increase the output of the property. To the end of 1874 the total production of the claim was 154 tons of tin oxide. By the end of 1877 the output had increased to 3433 tons, the value of which at Mount Bischoff was at least £100,000. Wages took nearly £50,000 of that sum, and transport also a large proportion. Sufficient profits, however, were won to enable the company to declare its first dividend, which was at the rate of £1 per share or four times as much as the total previous calls. It should be added that Mr. Kayser remained in absolute control of the property until three years ago. His management was vigorous, and carried the company to the front. Those who may criticize some of his methods must remember that they speak in the light of a later day. Mr. Kayser had to evolve a scheme for operations that had no parallel in Australia. He did this with success and with a zealous consideration for the welfare of his company.

The study of the district indicates that the slates (believed to be pre-Cambrian) were first laid down, then followed the intrusion of the porphyry, and next the formation of lodes. The geology is complex. The observer is impressed by the fact that under a cap of hard quartz-porphyry exist vast masses of detritus. How this detritus got into position is a matter for speculation. Open-cut work has removed much of the southern portion of the outcrop, and the first impression, as a visitor approaches the mine from the town of Waratah, is that he sees the whole of the workings of the mine. But beyond a ridge of white rock lie the main workings. These have been hollowed out, like a crater, the northern rim being nearly 200 ft. high. Beyond these excavations are the western and northern slopes, where but little mining is being done. In the central workings are

GENERAL VIEW OF MOUNT BISCHOFF.

CONTINUATION OF UPPER ILLUSTRATION.

seen brown faces of friable material, consisting of altered quartz-porphyry and slate coloured by iron pyrite. It is a fact of great interest that boulders of gossan 90 tons in weight and rich in tin have been found not only on the southern slope of the mountain but far down the northern slope where the descent is almost sheer for over 1400 ft. to the river. It is a point of the greatest interest to know whence these boulders came. If they indicate the presence of tin-bearing ground on the northern slope of the mountain, the possibilities of the mine becomes correspondingly enlarged. In any case the presence of such boulders on opposite slopes of an exceedingly steep mountain is a phenomenon of unusual geological interest. Another feature of the deposit is the big bands of decomposed pyrite, as black as ink. It was a saying of the old practical miner that "when pyrites is reached look elsewhere for tin." This axiom, like so many others, is now disproved.

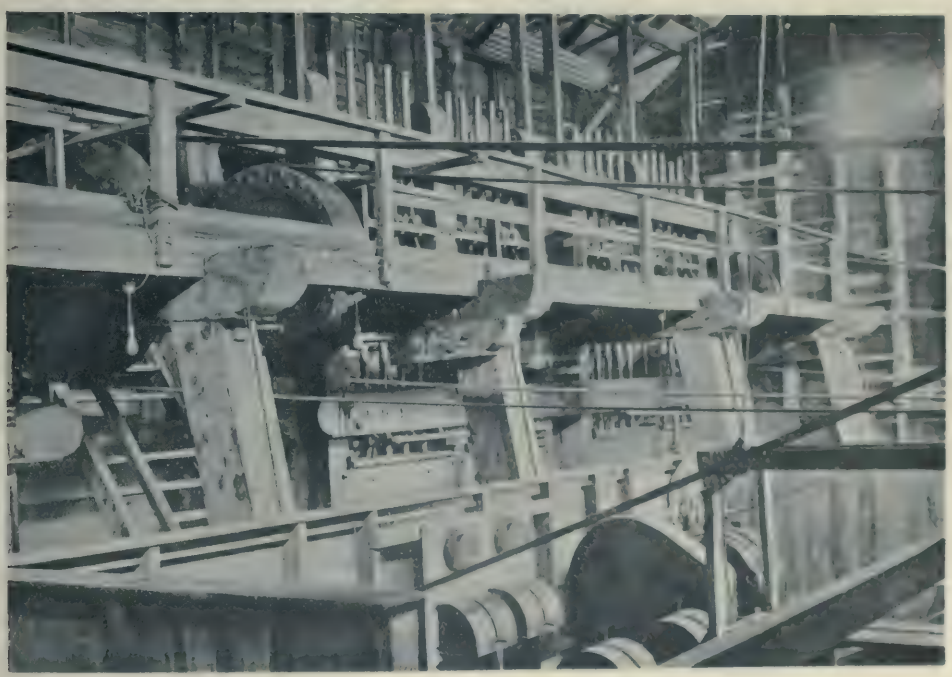
The recent history of the mine is like a fairy story. And the fairy was science. First it was proved that the tin-bearing talus was directly related to the overlying tin-bearing porphyritic rock, and if it could be proved that the adjoining barren rock contained elements similar to that existing in the ore then a chance existed for the mine, because further work might reasonably be expected to expose further reserves. This generalization was due to J. D. Millen, an Australian student, who had been attached first to the metallurgical staff of the company at its Launceston smelting works and next had been appointed by the directors to act as their scientific adviser. Mr. Millen was a keen microscopist. His first step was to make a thorough examination of the barren rock. This investigation went on the assumption that Daubré's theory in respect to the deposition of tin from gaseous vapours was applicable to the Mount Bischoff deposits. Mr. Millen ascertained that topazation of the porphyries had taken place in rocks that were supposed to contain no tin. Following the line of work done on the Schneckenstein rocks in Germany, it was decided to prospect for ore wherever the microscope disclosed laths of topaz. This application of petrology to mining has been crowned with complete success. Mr. Millen was given funds for the prospecting. Whatever scepticism existed when he took control has now disappeared, for results have ensued. The talus under the supposed barren rock has proved tin-bearing, and beyond and underneath the huge bands of pyrite the brown detritus has been discovered to be highly profitable. A fact established by the microscope was that the altered slate carried tin. These facts are recorded not to disparage the earlier work but to show the value of applied science.

Mining at Mount Bischoff is simple. Open-cut work is supplemented by tunnels and rises connecting the faces on the south slope of the mountain and the inner brown faces. The 'wash' and rock are easily broken, each shot bringing down big masses of material. This is shovelled by hand into trucks moved by electric or steam traction to the mill, a mile distant. Work at the mine, however, is being entirely re-modelled. Instead of a number of small independent faces with a 'bank' of rich ore reserved here and there, and with work stopped where the pyrite or so called barren rock appeared, the whole of the deposit is being attacked in regular benches. The result is that more system is possible and a vastly greater area is available as a source of supply for the mill, which will shortly be connected with the mine by an aerial tramway. The ore will first be fed into gyratory crushers at the foot of the lowest bench and after being broken to a $2\frac{1}{2}$ in. gauge will be delivered into self-tipping trucks. The drop from the loading-station at the mine to the battery is 142 ft., and the delivery will be at the rate of 100 tons per hour. The cost of transport, through the use of the crusher and of the aerial ropeway, is to be reduced from $4\frac{5}{8}$d. per ton to $2\frac{1}{2}$d. per ton.

The chief sources of ore-supply are the white face on the southern slope and the Don workings. Some of these are five benches in height. Rich seams of tin ore can be detected, but the whole mass is worked so as to give an average of about $\frac{1}{2}$% tin per ton. Independently of these surface workings, a considerable amount of development has been done underground on the porphyry dike known as the Queen lode. In the work carried out by Mr. Millen it was found that isolated bunches of rich ore were frequently cut; these he concluded were formed by replacement following lines of fissuring and crushed zones. Therefore the slate walls of the dike cannot be taken as proof that no ore exists beyond their limits, as cross-cuts have on several occasions penetrated detached ore-shoots.

The battery consists of 90 stamps; of these 80 belong to the old mill and 10 to the new. The weight of the old stamps is 562 lb., that of the new is 1050 lb. Owing to the sticky nature of the ore, it is fed by hand. The average grade is a shade over 0·5% tin; the

THE MOUNT BISCHOFF MILL.



INTERIOR OF THE MILL.

tonnage treated has been increased within the past three years to 118,000 tons per annum, with a reduction in costs from 6s. 7d. to 3s. 11d. per ton. The old battery is of the ordinary type and the boxes have a discharge area of 3 sq. ft., the top of the dies being kept on a level with the screen-opening. The stamps of the old battery drop 8 inches 88 times per minute and the duty is 7·5 tons per 24 hours, this being possible because of the friable nature of the material crushed. The screens in the old battery are 12-mesh wire, and in the new battery a 10-mesh screen is used. The stamps of the new battery drop 8 inches 90 times per minute.

Classification constitutes a dominant feature of the milling. In the old mill the pulp, after leaving the battery, passes to spitzlutten, in pairs, the upward flow of water acting as a sorting column. The overflow goes to settlers and thence to tables. The grains for the spigot are drawn off into a V-shaped box with ends sloping at an angle of 60°. Sand from the first spigot goes to the coarse jig ; that from the second to the fine jig. Sizing tests of the material delivered into the coarse jigs show that 81·3% of it will remain on the 40-mesh screen, 12·5% on 60 mesh, and 6% on 80 mesh. The pulp to the fine jigs shows the following grades :

Screening	Sand to fine jigs %
Coarser than 40	50·0
40 to 60	37·5
60 to 80	1·5
80 to 100	5·1
Finer than 100	7·9

The jigs are of the Hartz type and are divided into four compartments, of which two are for the plungers and two for the concentration. The product of No. 1 hutch is ready for bagging and that of No. 2 hutch is re-treated and if necessary sent to a dressing jig. The coarse jigs make 200 pulsations per minute on a $\frac{5}{16}$ in. stroke and the fine jigs 250 pulsations on a $\frac{3}{16}$ in. stroke. The coarse jigs treat 10 tons per day and the fine jigs 13 tons per day. The ratio of water to sand is 11 : 1 in the coarse jigs and 7 : 1 in the fine jigs. The tailing from the jigs goes to classifiers and thence to Card and Wilfley tables. These also treat the middling from rotary tables, which handle the overflow from the spitzlutten, after it has passed through spitzkasten. The fine sand from these rotary tables goes to Luhrig vanners and rotary tables. The latter is a convex slime-table 16 ft. diam. with a slope of 5·5°, the axis of the table being vertical and the feed starting near the centre. One revolution is made in two minutes and the different products are caught in a launder at the edge of the table. Of the feed 73·8% will pass through 100 mesh and 15·3% through 40 mesh. The concentrate is bagged, the middling as stated going to the Card and Wilfley tables, and the tailing into settlers and thence to the slime department.

As will be gathered from the foregoing, the duty of the Card and Wilfley tables is to treat the middling from the rotary tables, the tailing from the fine jigs, and the coarse sand from the spitzkasten. 'Seconds' from these tables, after being re-ground, are treated on Card tables and the middling from the other tables passes to a Sperry vanner, while the concentrate goes to the tossing tub. Of the coarse sands fed to these tables, 53·5% will not pass through 40 mesh, and 35·5% come from the 60-mesh, while of the material from the spitzkasten 20·4% remains from the 60-mesh and 50·3% has passed through 100-mesh. The Card tables are of the 'B' model and so arranged as to give a toggle motion by means of a tension-rod. The speed is 258 strokes per minute and the slope 2·75°. The fine jigs, followed by the Card tables, extract 86·7% of the total tin contents of the material drawn from No. 2 spigot of the spitzlutte.

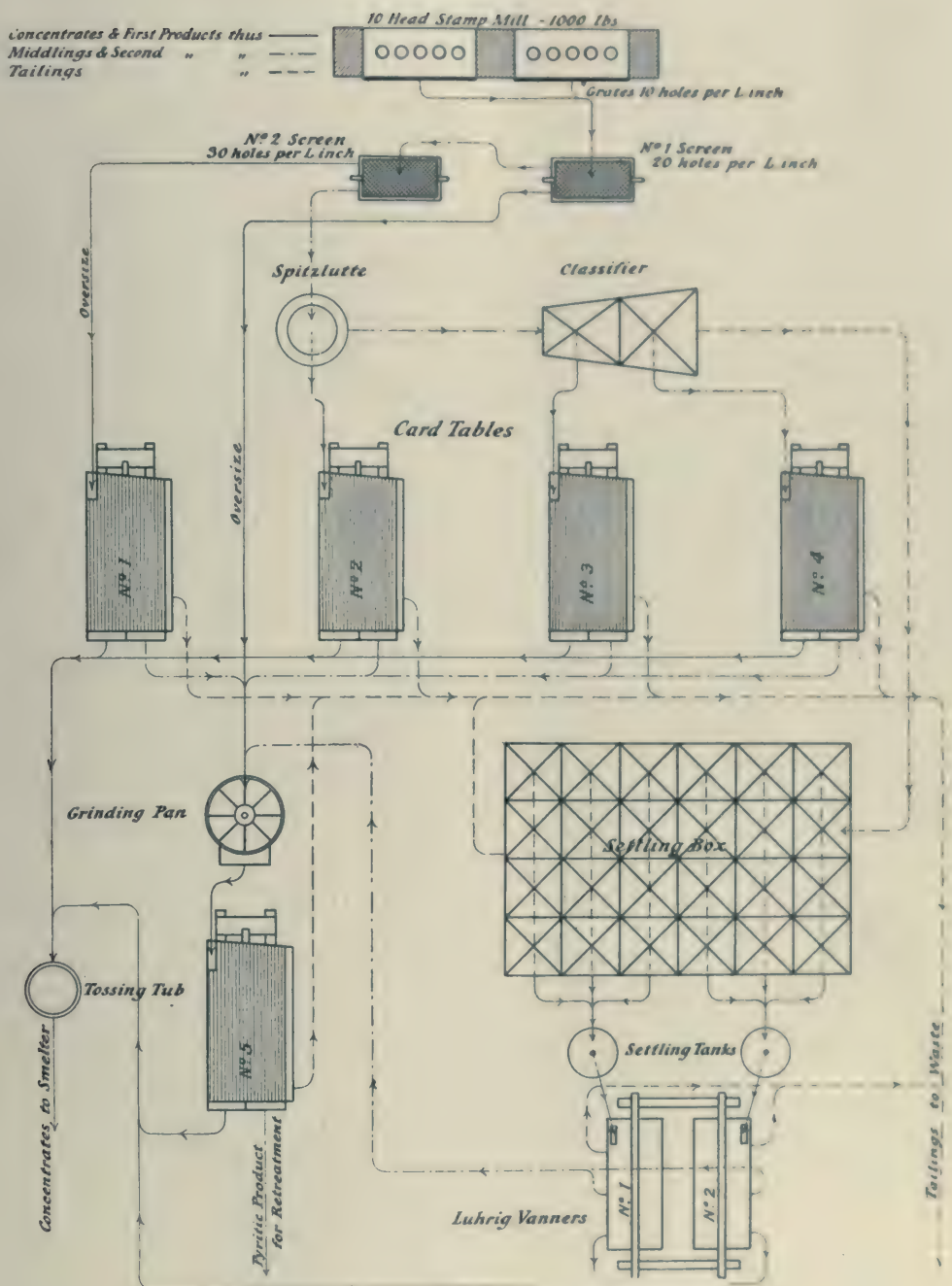
The Wilfley tables (No. 5 model) treat similar material and are run at 240 strokes per minute when treating coarse sand and 243 strokes when treating the fine sand, the slope being 2·6°. Examples of the work done by the two sets of tables are furnished as follows :

	Tons treated daily	Water to sand	Extraction %
Card.....	25	4·1 : 1	66·99
Wilfley	23·5	4·2 : 1	65·14

Fine jigs followed by Wilfleys extract 86·06% of the total tin contents of the material from No. 2 spitzlutte.

The Luhrig vanners (duplex type) treat about 18 tons per day. Their slope is 4·5°, the belt travels at the rate of 6 ft. per min., and the bumps are 150 per min. The material fed to them is finer than 100 mesh and the tailing assays 0·03%. The middling from these vanners goes to the Sperry tables, which are convex, 10 ft. diam., with a circular vanning motion of 200 throws of 0·3 in. per minute. The work is not altogether satisfactory owing to the fineness of the slime. The Sperry tables revolve once in 1¼ minutes and have a slope of 5·5°.

The coarser sand from the Card and Wilfley tables is re-ground in a Forwood-Down pan.



FLOW-SHEET OF NEW MILL AT MT. BISCHOFF.

The nature of the operation is shown by the following figures:

Screening	Sand entering %	Sand leaving %
Coarser than 40	63·3	3·9
40 to 60	24·6	5·5
60 to 80	4·4	3·8
80 to 100	2·9	3·4
Finer than 100	4·8	81·4

The slime-plant consists of rotary and Card tables, with the necessary settling tanks.

The total recovery achieved by the mill is 81% of the tin in the ore. Of that, 24·1% is won by the coarse jigs, 19·2% by the fine jigs, 43·1% by the Card and Wilfley tables, 3·5% by the Luhrig vanners, and 10·1% by the rotary tables.

As several modifications of treatment have been introduced in the new mill, the flow-sheet is given herewith. It will be seen that the new system of treatment is much simpler. Jigs and buddles have been abolished; the sand is treated on Card tables and the slime on vanners. The screens in the stamp-mill are 10-mesh. The discharge goes first to No. 1 screen of 20-mesh; the oversize is sent to a grinding pan and the material passing through goes to a No. 2 screen, equal to 30 mesh. The oversize from the latter goes to No. 1 Card table. Classifiers divide the fine into four products, three treated on Card tables, and the fourth or finest sent to settlers and subsequently treated on Luhrig vanners. The middling from the four Card tables is sent to the grinding pan and then to No. 5 Card table.

The management realizes the importance of constant checking, therefore the results at the mine and in the mill are constantly tested. Sampling has been systematized so as to secure the fullest evidence as to the points at which loss may occur.

The actual working costs for the last six months are as follows:

	s.	d.
Mining, including new works, stores, etc.	2	1·248
Filling, hauling, and emptying trucks	0	4·624
Milling and concentrating, including maintenance and ore bagging	0	10·917
Prospecting and development work	0	1·528
Electric running	0	0·629
Surveying	0	0·440
Assaying and sampling	0	0·799
Races and dams	0	0·584
Administration	0	2·444
	3	11·213

The company smelts its own ore; this is done at Launceston, where the company also handles a substantial quantity of purchased ores. Within the past two years this portion of the plant has also been re-organized, four large furnaces having been erected. The quality of the tin produced is so well recognized that it constitutes a record for the efficiency of the staff. The smelting is under the control of F. B. Jackson, the operations as a whole being under the supervision of J. D. Millen.

The plant consists of four reverberatory furnaces, with a capacity of 64 tons each per week. In addition, there is a calcining furnace for the treatment of pyritic ores, some of which contain arsenic and copper. A small leaching plant is in operation for the treatment of the copper-bearing tin ores, it being necessary to remove the above impurities before smelting. For the treatment of the furnace-bottoms there is a small stone-breaker and set of rolls, which prepare the material for the small concentrating plant employed for collecting the metallic tin. This tin is impure and is sent back to the furnace for further treatment.

The ore as received varies considerably, practically the whole of the tin produced in Tasmania being treated here. Care has to be exercised in blending these ores for smelting so as to obtain the best results, the object being to make a self-fluxing mixture. The charge consists of about 4 tons of ore with from 12 to 15 cwt. small coal, which acts as a reducing agent. A charge is smelted in about 8 hours, during which time it is subjected to several rabblings. When the charge is reduced the tin sinks and the slag floats thereon. The tin is first tapped into a brick-lined vessel, after which the slag is drawn into sand beds and reserved for further treatment. When the tin has cooled a little, it is transferred to the refining-kettle. Green logs of wood are lowered beneath the surface. The heat of the metal converts the moisture of the wood into steam; the steam, forcing its way to the surface, causes the tin to be violently agitated, so mechanically liberating the dross, which then comes to the surface. The dross is skimmed off and re-treated with the next charge.

When re-smelting slag, the resulting metal is very rough; it is subjected to liquation and converted into ingots fit for the market.

The company is willing to smelt ore for the largest companies in Tasmania and returns them the metal, if desired; a deduction of 2% is made to cover smelting loss on an ore assaying 70% and a further deduction of 1% for 65% ore. The amount of ore smelted is approximately 4500 tons per annum.

TIN MINING IN BOLIVIA

By WILLIAM GRAY and ARNOLD L. HALDEN.

NOW that Bolivia has enjoyed the blessings of peace and prosperity for a goodly number of years, it is no wonder that this 'Core of the Andes' should have attained second place among the tin-producing countries of the world. The great impulse, of course, came in the booming times of 1905-7, when Straits tin was quoted at £200 a ton. So great was the impetus then given to mining in Bolivia that the effect of the reaction in 1907, when the price suddenly collapsed to £120, was not as severe as might have been expected. Moreover, now that prices are in the neighbourhood of £150, Bolivian mine owners are well content, and they are putting forth every effort to develop their properties and increase their production; for £150 is a highly satisfactory price and leaves a substantial margin of profit, in spite of the many difficulties of mining and the cost of transport.

Centres of Production.—We may commence our description of the chief centres of tin production in Bolivia at the present time with Uncia, a township belonging, politically, to the department of Potosi, but from a practical and business point of view connected with Oruro, the metropolis of the Bolivian tin industry. The district of Uncia has recently acquired great fame as an abundant source of tin. It is situated 66 miles northeast of Challapata, a station on the Antofagasta and Bolivia railway. The concentrate is brought to this station and carried by rail to Antofagasta from which port it is shipped to Europe. The first mining company to make this district famous was the Llallagua, now owned in Chile. The monthly production of concentrate varies from 6000 to 8000 Spanish cwt. assaying 65% metal. The second mine opened was the Salvadora which at present is the most productive in the country, having a monthly output of 12,000 to 18,000 cwt.; this mine is owned by a native Bolivian. More recently the Uncia Mining Co. has developed a mine of promise giving a monthly output of 4000 cwt. All these mines have aerial ropeways, mills, and plant of the most modern type and are steadily increasing their production.

Next in importance and only quite recently overshadowed by its neighbour, Uncia, is the mining district of Huanuni, 30 miles southeast of Oruro. The concentrate from this district is brought to Machacamarca station, on the same railway. The tin-bearing hill of Pozoconi, of old renown, belongs, in nearly equal parts, to Penny & Duncan and to the Huanuni Tin Co. The joint production averages 8000 cwt. per month and the concentrate has

A Bolivian Miner.

the distinction of being the highest quality Bolivia, having an assay-value of 66 to 72% of tin.

Adjoining Huanuni on the northeast is the Morococala mining district, which has produced tin for many years. The mines have only recently been consolidated and now belong to

Penny & Duncan. They are connected with a new mill at the foot of the hill by an aerial ropeway 8 miles long and erected at a cost of £12,500.

South of the Huanuni and nearer Pazna station is another district, which has fallen on evil days. Antequera used to be a great name, but two of its chief producers have come to grief a few months ago and have been closed at least temporarily. Avicaya, the only mine now worked on the Chualla Grande hill affords an example of the survival of the fittest; it is a model in every way, though its output is limited.

Between Oruro and Cochabamba are the tin-mining districts of Negro Pabellon and Berenguela; these are making spasmodic efforts to come to the front again, but they are handicapped by the great distance from the railway and by want of capital.

Between Oruro and La Paz, the Tres Cruces and Santa Vela Cruz districts gave promise of great things a few years ago, but have succumbed to adverse climatic, labour, and transport conditions. Huaina Potosi, on the other side of La Paz, is fighting hard against fate and we are unable to say what is its actual present position.

The world-famed Potosi has long been obliged to smelt its tin ores on the spot, owing to the prohibitive cost of transport to the railway, 10 to 15s. per cwt. At present the production is 2000 cwt. of tin bars per month. In another eighteen months, however, this district will be linked to the Antofogasta and Bolivia railway at Rio Mulato, when freight will be reduced to 2s. 6d. per cwt. and Potosi will no doubt become one of the leading exporters of Bolivian tin. There are many rich tin deposits between Potosi and the Argentine and Chilean frontiers, all waiting for more favourable conditions, and capable of being worked by both small men and big companies.

Economic Conditions.—The export of tin concentrate from Bolivia has been steadily increasing from year to year, until, in 1909, it reached a total of 21,500 long tons of tin concentrate and tin bars. In these figures the concentrate is reduced to represent material containing 90% of bar tin. Now that the railway fever, the surest tokens of industrial progress in a new country, has laid its grip on Bolivia, the export of tin may go up, in the near future, by leaps and bounds. Besides the longitudinal trunk line connecting Antofagasta, Oruro, La Paz, Titicaca, Arequipa, and Mollendo, three other railways will soon be at the service of tin exporters, namely, those connecting La Paz and Arica, Cochabamba and Oruro, and Potosi and Rio Mulato, all in course of construction.

The cost of transport is the most important economic factor in the Bolivian tin industry. Crude ore is carried from mine to mill by aerial ropeways, in mule-carts, and on llama-back. The concentrate leaves the mill for the railway station mostly in carts, which come back with return cargoes of machinery, explosives, raw material, provisions, fuel, and forage, for the most part imported direct by each company from Europe, the United States, or Chile. Everything is dear, even native labour; but transport is the costliest of all, and is not always obtainable especially when llamas have to be employed.

The taxes imposed by the Bolivian Government consist chiefly of an export duty on ores, concentrates, and metals. In the case of tin, a sliding scale is adjusted fortnightly, in sympathy with the market price of Straits tin, by the Minister of Finance. With Straits at £150, the duty on every 100 lb. of tin concentrate is $1·60, Bolivian money.

This leads us to another serious question, that of exchange. Suppose a mine has to disburse $40,000, Bolivian money, every fortnight. When the Bolivian dollar is at 17d., it is only necessary to sell drafts for £2833. 6s. 8d., whereas, with exchange at 20d. the amount is £3333. 13s. 4d., representing a dead loss of £500 in perhaps a fortnight. Unfortunately, Bolivian exchange jumps up and down by fits and starts, in obedience to the balance of trade and the consequent supply of and demand for bills of exchange. We have in Bolivia the curious phenomenon of a double standard of exchange. The metallic reserves of the national emission banks are mostly in English sovereigns, and this coin is legal tender at all times, at the fixed rate of $12·50 to £1, that is, 19⅕d. per dollar; but it only circulates freely when exchange is above par, for reasons patent to anyone conversant with the science of banking. The variable exchange we have mentioned already. The consequence is that, while the sovereign is never worth more than $12·50, £1 on a bill of exchange, even at 90 days, will often buy $14 of Bolivian currency.

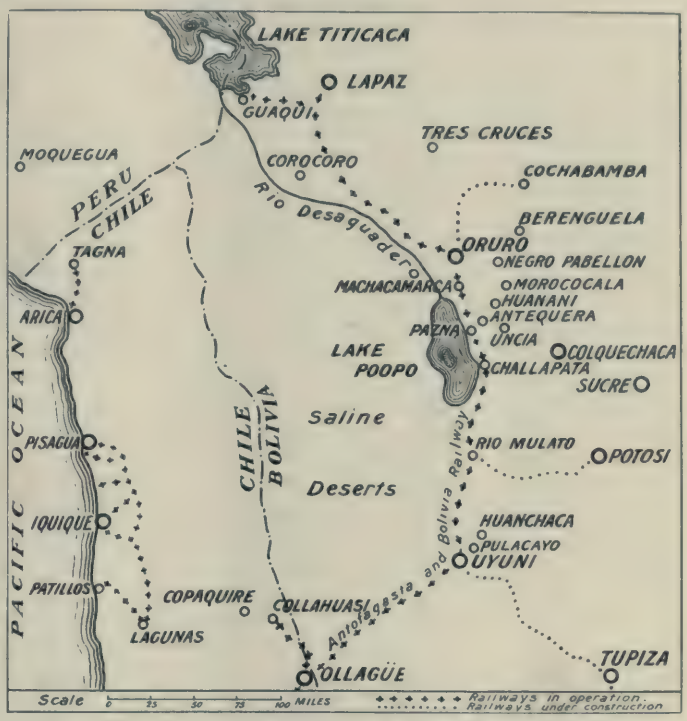
There are several third and fourth rate local emission banks in Bolivia, the paid-up capital of which varies from one to two hundred thousand pounds, all private corporations. Endeavours are being made to establish a Bank of Bolivia, with government guarantee, but this cannot be done without the help of a loan of

£2,000,000 from British, French, or German bankers and, so far, application has been made in vain. As might be expected, the small emission banks are opposing the Government's plan tooth and nail, while the branches and agencies of foreign banks established in Bolivia are interested spectators. For the information of our readers we may add that the Bank of Bolivia and London has a branch in La Paz, and the Anglo-South American Bank an agency in Oruro.

Mining Laws.—The laws that govern and supposedly protect mining property and the mining industry in Bolivia are, in themselves, as good as can be found elsewhere, having been adapted to local conditions from the mining laws of Spain, but their application is quite another matter. In Bolivia possession is nine points of the law. In the case of old mines, temporarily abandoned or only spasmodically worked, it is pretty certain that title-deeds will be found in the possession of old residents, carefully stowed away and anxiously preserved as heirlooms, against the time when some enterprising stranger shall stumble on the mine, start work, and find metal where the natives had written, with Dante: "Lasciate ogni speranza, voi ch'entrate." No one will interfere or show the slightest interest in the work done by the stranger, the erection of plant, ropeways, and miners' huts, or the building of roads; but when the operations begin to pay, these wonderful old parchments will be brought forth to prove priority of possession. Before the unlucky miner has found out the meaning of all this, he has a round dozen of lawsuits confronting him. The odds are nearly always against the foreigner when recourse is had to the law, and the only possible way out of the difficulty is to buy all and every title-deed.

A timid investor should not go to Bolivia; no gloves are worn there when dealing with mining property or mining rights. All the successful investors in Bolivian mines, once in the possession of a good thing, have stuck to it, fought for it, and worked out the problem to a finish, in the face of the most persistent and most annoying opposition. This is especially true of the few Britishers who have made their fortunes in that country; their ability and tenacity have stood them in good stead.

These conditions may make an investor ask "Is the game worth the candle"? The answer is simple enough. If the tin industry in Bolivia did not pay well, there would not have been this great increase in production and export. In a future article we hope to give some statistical information relating to cost and profit. Suffice it to say now that the ideal average net profit of the Bolivian miner, often realized and sometimes exceeded, is £1 per cwt. on good 65% barrilla.



The Tin Districts in Bolivia.

[The map accompanying this article shows other important mineral districts, in Bolivia and northern Chile, in addition to those noted for tin. The famous Huanchaca silver mine is to the south; it was for the special benefit of this mine that the Antofagasta & Bolivia railway was first mooted. The Collahuasi copper district is shown just over the Chile border. Further to the north are the Corocoro copper mines. The copper sulphate deposit at Copaquire attracted attention in England six years ago. Many unsuccessful attempts have been made to utilize this sulphate and to extract it from the rock. Further to the west is the nitrate district, in the mountain ranges behind Iquique.—Editor.]

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

The Square Fathom.

The Editor:

Sir—I have followed with considerable interest the discussion which has appeared in your columns and in other technical journals regarding the 'Square Fathom' proposal put forward by Mr. Marriott. I have noticed that some of the criticism is calculated to belittle the proposal without putting forward adequate or serious reasons for so doing.

It is idle to ridicule innovative suggestions regarding the administration of a vast industry when those suggestions emanate from a man who is identified with the chief house in the control of that industry. It is too serious a matter to permit of personal vituperation or ill-disguised sarcasm. It is only fair to give that man credit for having most exhaustively thrashed out all the details involved in the principle of the revolutionary measures which he advocates. In fact it may at once be safely concluded that many trenchant reasons will be disclosed by a study of the case, and that independently of the nature of the final judgment, the scheme will prove at least worthy of the most serious consideration.

It is claimed by Mr. Marriott that there are a number of prejudicial features bound up in the time-honoured use of the ton-unit as the basis of all mining returns, and the use of a new unit is suggested, whereby the undesirable features of the present system may be eliminated.

To most mining engineers the use of the ton unit has from time to time presented difficulties that have been quite obvious, but for which there appeared to be no remedy; and it has always been recognized that any statement of tonnage can only in the nature of things amount to an approximation, but (and this is an important reservation) an approximation within reasonable limits. That is to say there are elements in the computation of tonnage that must be uncertain despite the most stringent method adopted in framing those computations. It is the practice today in an up-to-date mine to check the tonnage statement in many ways: (*1*) There is a record kept of the number of trucks from any given stope; (*2*) of the trucks tipped at any given station in a hoisting shaft; (*3*) of the number of skips or trucks hoisted through any shaft; (*4*) of the number and weight of trucks to the mill-bins, or alternatively an automatic register is kept of the weight of ore carried on any conveying arrangement for the mill-bins; (*5*) (if any sorting is done) of the number and weight of trucks of waste rock discarded; (*6*) of the measurement of sand-treatment tanks after filling; (*7*) of the number of truck-loads discharged on the tailing heaps; (*8*) of the amount of slime treated.

From the data represented in the foregoing records, it is possible by working back from residues to truck records (or stope measurements) to apply a number of approximate checks, and if this work is done conscientiously there can be no question that the final computation should come within a maximum error of 5%, and generally speaking the limit of error would be much narrower. The factor of greatest uncertainty in returning the weight of the uncrushed ore is that of the percentage of moisture, and no matter how carefully this may be estimated the result can only be approximately accurate. Another point of variation lies in the percentage of sulphides contained in an ore, and, in the experience of the writer, the tonnage calculation has been upset from this cause on more than one occasion. For instance, in a mine which is operating two reefs, one of which is highly pyritic, and the other practically free from pyrite, the percentage of these reefs worked in any given month may vary considerably and the weight represented by a car-load of ore will correspondingly be found to vary to such an extent that the effect is appreciable in the total weight of the ore handled over a period.

It must be clear that where the primary elements of the computation are of so involved a nature, it is too much to hope that absolute accuracy could ever be established, but the question arises as to whether the degree of accuracy obtainable in the circumstances will satisfy all the practical requirements of the case.

In working down to the finer points of profit and loss most engineers have at one time or other longed for something more tangible than the tonnage statement, but nevertheless by constant and universal use the ton has become a habit, the dropping of which would only be most reluctantly agreed to. Despite that, however, if a new unit will bring in its train the abolition of the difficulties recognized under the old one, most engineers will extend to that new unit a cordial welcome; but they will naturally require to be quite convinced that it possesses at least all the virtues of the old one, before any exchange can be finally approved.

In the circumstances, therefore, and in view

of the fact that Mr. Marriott has submitted a definite suggestion for consideration, it would appear to be advisable to tersely categorize the alleged evils of the ton unit, and the benefits of the square fathom unit as presented by him.

Mr Marriott summarizes the disadvantages of the ton unit thus:

(*1*) That mine managers labour under considerable disadvantages in the declaration of outputs, profits, and working expenditure, both in the aggregate and on the unit basis.

(*2*) That the manager of a rich mine gets more than his fitting share of kudos in comparison with the manager of a poor mine.

(*3*) That it tends to a desire to get low working costs, without regard to the principles of true economy.

(*4*) That it leads generally to abuses which directly or indirectly affect prejudicially (*a*) the manager and staff, (*b*) the operations of the mine, (*c*) the profit-earning capacity of the mine, and (*d*) the intrinsic value of the shares.

(*5*) That it leads to the issue of complicated statements that are prepared only at great and unnecessary cost, that really do not reflect the actual position, and that are in fact misleading.

The advantages of the fathom unit are claimed by Mr. Marriott to be:

(*1*) That it at once simplifies the statements of revenue and expenditure and reflects much more clearly and accurately the vital features of economic importance.

(*2*) That it will at once expose the fallacy of the clamour for low working costs at any price, by indicating in each specific case what percentage of the ore developed can be mined at a profit.

(*3*) That in reflecting the true position of a mine it will dissipate the unfair comparison of returns, introduced by the ton unit; that it will encourage a spirit of "maximum profit consistent with the known average value of a mine" rather than a spirit of "minimum cost without regard to profit"; and that it will tend to the growth of an unhampered policy in the exploiting of a mine which shall aim at realizing the maximum "present value."

(*4*) That finally the unit of area is a more rational and intelligible counter, for the reason that it bears a direct relationship to the wasting nature of the asset that a producing mine represents.

This summarizing of the position represents the interpretation placed by me upon Mr. Marriott's statement. It is not put forward in Mr. Marriott's own words, and may not altogether meet with his approval, but I think that it is a broad and faithful representation of his views. To my mind, however, it is not clear that the results claimed by Mr. Marriott can be achieved. In fact it is really not easy to convince myself that the possible disadvantages of the use of the new unit may not more than counterbalance many of its problematical advantages.

To begin within, the 'square fathom' measured on the plane of a reef does not to my mind convey very much unless I am informed at the same time of many other points that have a pertinent bearing on the question of value. For instance in the Roodepoort section of the Witwatersrand there are stretches in which only one reef has been worked, having an average thickness of under 12 in., whilst in the Central Rand there are instances in which three reefs have been almost continuously worked in one section, each reef having an average thickness of over two feet. The square fathom as a unit of calculation in these two cases refers to conditions that are so entirely different as to make any comparison on that basis absolutely meaningless, seeing that there could be no correspondence whatever in the results obtained on that basis. I quite understand that Mr. Marriott would reply that it is this invidious comparison which he wishes to avoid, and that the exaggeration of the difficulty by the use of the square fathom unit is therefore desirable because it at once dispenses with any question of comparison. To me it seems a doubtful advantage to be placed in this position. Although, on the tonnage basis, comparison between the two cases is also most difficult, it would yet appear to bring something more definite to the mind than the square fathom unit.

It is all very well to talk about doing away with comparison as between mine and mine, but it cannot be done. The man who invests his money in a mine will compare, and must compare, in order to arrive at a decision in the placing of his investments, and however difficult or however erroneous the results may be, he must resort to comparison in some form or other.

A ton after all is more or less a ton, the more or less depending on the care taken to make the statement accurate; and taken as a unit therefore, whether it be in calculations of revenue or expenditure, of profitable ore, or unprofitable ore, it must have to both the operator and the investor a fairly clear meaning. Naturally a ton may readily be used as the basis for calculations which may be quite misleading, or its use may give rise to comparisons which in reflecting the details of the returns

from a number of mines may show that some are doing better than others, and the manager of a rich mine may therefore undeservedly enjoy a reputation for capability that his more capable confrere on an adjoining mine does not possess. These things are notoriously true, but are they not errors rather of human judgment than the consequences of the use of a wrong unit? And is the substitution of a new unit at all likely to bring about any such material revolution in public judgment as that indicated in Mr. Marriott's suggested remedy.

To proceed, however, it is not easy to follow Mr. Marriott in his deduction that because values are stated on the square fathom basis there will no longer be any inclination to mill ore which on its valuation is apparently unprofitable. Mr. Marriott points out that, in order to keep mills running at full time and in order to keep working costs at a low point, a great deal of ore is extracted from a mine which is really unprofitable and which is handled therefore at a loss; and he therefore suggests that, if only such portion of the stamps were in operation as would be required to crush that percentage of profitable ore available at any given time, the operation would be attended with economic advantages, and he suggests that these advantages would attach to the use of the square fathom unit.

No one will gainsay the fact that it is unprofitable to mine and treat ore which yields less per ton than the actual cost of handling it, and no one will deny that from a theoretical standpoint the desideratum at which the mine manager should aim is to extract the ore of the highest grade as quickly as possible so that the interest loss as represented in the 'present value' calculation should be reduced to the smallest figure. To be in a position, however, to arbitrarily select the ore which answers to this description in a mine, it is necessary to first postulate a great many conditions that in general are conspicuously absent, and also to ignore many conditions that in practice would make this policy an exceedingly difficult and expensive one to follow.

By the present methods of valuation we endeavour to arrive at the value of a block of ground by carefully sampling its four exposed sides, but it has been proved on many occasions that although this system is the best that in the circumstances is available it can by no means lay claim to great accuracy, and there are numbers of instances on record where the values indicated by this method have in subsequent stoping operations proved to be very wide of the mark.

In the practice of mining there are times and conditions when the mining of low grade ore becomes necessary to the proper carrying out of stoping operations. On the Rand this has proved to be specially true, since a large number of the mines are subject to much faulting and it is not uncommon in one stope to have to work through a series of small step faults all of which necessitate the inclusion of considerable amounts of waste rock. In this way the original estimate of the value of a block of ground may suffer a violent reduction. Even on the Witwatersrand where values are popularly supposed to be so extraordinarily uniform there are frequent and sometime radical changes in the grade of the ore which upset all calculations; and not unfrequently it has happened that after making all the arrangements to mine the ore from certain stopes, it has been found necessary, owing to the difference in grade disclosed when actual stoping began, to shift to some other part of the mine.

Another point that requires consideration is illustrated in the following case: We have a mine with two reefs, one of them rich, and the other just on the border of profitableness. The rich reef is a narrow body, the low grade reef is a big body. After careful calculation it has been determined that by mining these two orebodies at the same time the ore from the larger body can be broken at a nominal cost per ton, for the reason that the same skilled labour necessary to supervise the work on the rich reef can be made to also direct the work on the poorer reef, whilst the cost of air-power, hoisting-power, and other contingent general charges, can be much more economically spread over the larger tonnage handled. To such an extent do these considerations affect the operating cost that by working the two reefs together the poorer reef can be made to show a small profit, whilst the profit on the richer ore body is simultaneously enhanced.

On the contrary if it be decided to mine only the richer ore, and using say only half the stamps, the cost per ton will rapidly increase, whilst the poorer orebody will have to be left standing in the mine as unprofitable. In other words, when bearing only a portion of the general charges it could be worked at a profit, but not otherwise.

Mr. Marriott would argue that the 'present value' of the gold in the richer ore would be suffering an interest depreciation in this proposal that would more than offset the apparent advantages of the alternative policy, but it is here that I would join issue with him. His illustration of the Robinson and the French

Rand combined ore is of course not applicable to my case above cited. I admit at once that the question is an exceedingly delicate one, and it is a nice calculation to decide at what point the advantages will outweigh the disadvantages, but I submit that there will be many cases in which this policy could be adopted with the greatest advantage.

But these are problems surely that apply just as acutely to the tonnage-unit as to the square fathom. In fact I have battled with such problems for many years past on the tonnage basis, and I fail to see that I can gain any assistance in the settlement of the question by the adoption of the square fathom unit.

Frankly speaking it appears to me that Mr. Marriott is attaching blame to the use of the tonnage unit where his quarrel lies really with the administration of the mining industry. The difficulties that he mentions are evils which belong directly to the methods of administration rather than to the use of the unit, and the invidious comparisons that he strongly objects to have been more consistently made by the financial leaders than by the public.

Mr. Marriott has promised that he will substantiate his contentions in practical form in the near future, and I am sure everybody will watch with interest the development of his ideas. In the meantime, however, it appears to me most difficult to believe that the mere substitution of one unit for another in mining calculation is to have those revolutionary and far-reaching effects which Mr. Marriott claims.

To my mind the most important point raised by Mr. Marriott is in connection with the realization of the 'present value' of a mine. There is no doubt that in the war of 'low working costs' this vital feature has been to some extent neglected, and whether it be through the medium of a change of units or any other equally relevant or irrelevant change, a great deal of good will have been accomplished if some definite progress can be shown in the treatment of this industrial factor.

H. S. DENNY.

London, August 15, 1910.

Royal School of Mines.

The Editor:

Sir—I notice that, in an editorial in your August number, you remark on an anomaly exhibited by a reply of the President of the Board of Education as regards the cost of salaries in the Departments of Zoology and Mining at the Imperial College of Science and Technology. It seems that a really greater anomaly exists than that indicated by the figures given by the Minister. The list showing the result of the examination in advanced Zoology was: "Passed, 1st Class, none; 2nd Class, 1; failed none." This shows that only one student sat for the final examination in Zoology; whereas at the same time, 49 sat for the Mine Surveying examination and a greater number (unfortunately, I cannot give the exact figures) for the Mining examination. From the official figures it would appear that the cost, in salaries only, is more than three times as much per student in Zoology as in Mining and Mine Surveying together, on a total (including occasional students) student basis. Also it should be borne in mind that the £1900 spent in the Department of Mining is divided, as regards salaries, between two such important subjects as Mining and Mine Surveying.

The case of Metallurgy is about on a par with this, for the cost of salaries in this department is only £2000 and there were over 60 students during the past session. The Royal School of Mines, which does and has done so much for the Empire, should at least have equal treatment with other schools of science; it is high time that the acknowledged premier School of Mines of the Empire be endowed properly and not be hindered by lack of funds.

B. G. C. GARD'NER.

Pershore, September 3.

Mining in Korea.

The Editor:

Sir—Presumably because of my having had about 14 years' experience in Korea and that I am now interested in the development of two Korean concessions, several enquiries have reached me asking if the annexation of Korea by Japan will be likely to injuriously affect the interests of foreigners engaged in mining in that country.

Independent of the fact that prior to the promulgation of the annexation edict the Japanese government satisfied the American government (and doubtless all other Powers possessing direct treaties with the government of Korea) that no interference will occur with any rights legally acquired by foreigners doing business in Korea and that no revision of the existing customs tariff will take place for a period of ten years, there is, in my opinion, every reason to believe that it is the intention of the Japanese government to encourage liberally the development of the mineral resources of Korea absolutely without discrimination and, to every reasonable extent, to aid and protect all mining companies in the proper conduct of their business.

That Korea is a land of much mining promise is only now becoming generally known, although the progress made during the past year is considerable. I do not think there can be any doubt but what the several foreign mining companies now actively engaged in Korea can readily confirm the following extracts taken from the last Annual Report issued by H.I.J.M.'s Residency General:

"In order to encourage the investment of "foreign capital in mining development in "Korea, import duties on machinery, instru- "ments, explosives and chemicals necessary "for mining gold (including placer gold), "silver or copper, and export duties on "copper and concentrates of gold, silver or "copper, have been abolished by a law pro- "mulgated on August 19, 1908.

"Since the establishment of the Resi- "dency General in Korea, the Japanese "Government and the Residency General "have not only respected the mining rights "obtained by foreigners through agreements, "contracts or grants, but have also caused "the Korean Government fully to execute "contract obligations concerning bona fide "claims of foreigners. Moreover, the Resi- "dent General advised the Korean Govern- "ment to adopt the policy of positive en- "couragement towards foreign investment, "as the mines of the country could not be "developed by Koreans alone working on a "small scale with inadequate capital. The "provisions relating to supervision and re- "strictions in the first Mining Law, enacted "in 1906, were nothing more than prelimi- "nary measures to correct the chronic evils "then existing in the mining fields in Korea. "As already stated, the Mining Law, the "Customs tariff concerning mining machines "or mineral products, and even the Forestry "Law, were revised or enacted with a view "to encouraging the investment of foreign "capital. Postal and telegraph facilities "have been extended to mining districts "and police stations have been established "there."

The mining laws of Korea contain liberal encouragement for the experienced investor, to wit: the payment of a royalty of one per cent. of the value of the gross product, which together with an annual tax on the land under direct operation, constitutes the only taxation, whilst the Customs tariff is made free for the importation of all mining machinery and materials, and equally so upon all exports.

H. COLLBRAN.

London, September 1.

A Square Coin.—It is not often that a coin is any other shape than round. An example of an unusual form is to be found in the new 5-cent piece introduced recently in Ceylon. The old copper coins were cumbersome and it was therefore decided to replace them with a nickel-bronze coin. These coins were to be of the same weight as the new Indian anna, 60 grains; so in order to prevent confusion between them the Ceylon coins have been made square with rounded corners, thus following the fashion of some of the native coins of the East.

Refining Gold Bullion.—In United States patent 961,924, H. Wohlwill, of the Norddeutsche Affinerie, Hamburg, describes an improved method of conducting his process for electrolytically refining gold bullion. In his old process a high current density could not be used if the bullion contained much silver, and time was lost by the necessity for scraping at intervals the silver chloride that formed on the anode. If this chloride was not removed chlorine gas was evolved. According to the present invention the direct current hitherto used is superseded by a compound current produced by linking a direct current dynamo and an alternating current dynamo in series. It is found that by means of this compound current these drawbacks are removed; a higher current density can be used, and it is not necessary to be continually removing the chloride. Consequently bullion with high content of silver can now be treated.

Charging Blast-Furnaces.—Arthur S. Dwight describes, in United States patent 959,484, an improved mechanical distributor for copper ore charged into a blast-furnace. As is well known it is desirable that the finer portions of the charge shall be at the outside of the charge nearest the walls in order to distribute the upward blast evenly. A mechanical charging apparatus of the bell-hopper type is not applicable because the charge falls against the walls and rebounds and is thus not distributed in the way required; nor is it convenient for use in a square-section furnace where the length is so much greater than the breadth. Mr. Dwight's device consists of a square shaking structure placed in the mouth of the furnace leaving a narrow space all round for the ore to pass slowly down. The smaller particles of ore shake down and remain near the walls of the furnace, and when the remainder of the charge consisting of the larger parts comes to the bottom of the shaking structure it falls into the central part of the furnace.

COMPANY REPORTS

Burma Mines.—This company was formed in 1906 to acquire ancient lead-silver mines and slag heaps in Upper Burma, not far from the Chinese border. Bewick, Moreing & Co. are the managers, F. A. Govett is chairman, and H. C. Hoover is on the board. The mines had been worked by the Chinese, presumably for silver only; the carbonates had been practically exhausted and enormous quantities of slag high in lead and low in silver were found scattered all over the valleys. The report for the year 1909 shows that two smelters commenced operations in the early part of the year and treated 11,850 tons of slag and 912 tons of ore, producing 5029 tons lead and 26,398 oz. silver. The slag averaged 46% lead and 1·78 oz. silver and the extraction was 88% of the lead and 96% of the silver. The bullion sold for £57,222. The operating costs included £24,833 for the transport of the slag to the smelter, £23,007 for treatment, and £11,682 for freight and realization of bullion. The profit and loss account also contains items of capital expenditure on the railway, smelter, stores, etc., debenture interest, London expenses, mine development, etc., amounting in all to £121,000, and the adverse balance is £123,201 which is carried to the balance sheet. The company has been overweighted with capital and there were many different classes of ordinary and preference shares. Since the close of 1909 the capital has been rearranged by consolidating all the shares and writing them down to 312,046 shares of 4s. each, of which 286,508 carry a liability of 2s. The total nominal issued capital had previously been £355,589. Reports by W. J. Loring and by Gerard Lovell, resident manager, are also issued. From these it appears that a third smelter has been erected since the end of the year and that exploration at the mine shows that the Chinese had worked in sulphide ore as well as in carbonate. An outline of the proposed plan of development is given, and it would appear that the profitable exploitation of the property will give the engineers an anxious time.

Vivien Gold Mining.—This company was formed in 1902 by Bewick, Moreing & Co., who are the managers, to acquire and develop a gold mine 10 miles north of Lawlers, Western Australia. The issued capital is £76,000, and the equipment consists of 20 stamps and cyanide plant. No dividend has yet been paid. The upper part of the mine contains oxidized ore down to the 3rd level. On the 4th level however arsenical sulphide was found causing trouble in extraction. The report for 1909 shows that developments have not kept pace with the extraction, 26,000 tons having been blocked as against 41,146 tons sent to the mill. The reserve on December 31 was 35,219 tons averaging rather over 6 dwt. An intermediate level has been driven between the 3rd and 4th, approximately on the line separating the oxidized ore from the sulphide, and some useful ore has been found between this and the 3rd. The ore treated during the year yielded by amalgamation and cyanide 10,625 oz. or 21s. 10d. per ton, bringing an income of £45,078. The expenditure on development, mining, and milling was £45,011. Expenses in London, depreciation, income tax, etc., brought the expenses to £47,419, so that there was an adverse balance of £2241. W. J. Loring has recently paid a visit of inspection and reports that the plant is now treating the arsenical ore at a profit, though he is diffident in asserting definitely that the company is finally rid of its metallurgical troubles in this connection. His view is however cheerful on the whole. Development is to be continued by a winze on the 4th level before opening a 5th level from the main shaft.

Bibiani.—This company works a gold mine in West Africa some distance north and west of the districts of Tarkwa, Prestea, and the Ashanti Goldfields, and, owing chiefly to the difficulty of communication, has not made any distributable profit. The company was formed originally in 1899 and has been reconstructed twice, the last time in 1908. W. R. Feldtmann then reported on the property, and Hooper & Speak were made the consulting engineers. The report for the year 1909 shows that 57,576 long tons were treated in the battery; 45 stamps were in operation during the first half of the year and an additional 10 started in July. The yield by amalgamation was 16,305 oz. The cyanide plant treated 40,825 tons of sand and extracted 6965 oz., bringing the total production to 23,270 oz. valued at £98,669, or 34s. 3d. per ton. The working cost was £65,841 or 22s. 10d. per ton, and development redemption £15,953 or 5s. 6d. per ton. The total cost was £81,794 or 28s. 5d. per ton, leaving a mining profit of £16,875 or 5s. 10d. per ton. In addition, London expenses absorbed £2065, consulting engineers' fee £1635, debenture interest £4973, and depreciation £6874. Taxes and various small items of expenditure and income also appear in the accounts, and the final result of the year's operations was a balance of profit of £886. The consulting engineers last year pointed out the necessity for increasing the scale of operations in order to reduce costs. As already mentioned the stamp-mill has been increased; during the current year a slime-plant to treat 6000 tons per month is being erected. Also the amount of development work has been increased, and during 1909 totalled 6253 ft., an increase of 50% over 1908. The reserve ore on December 31 was 417,878 tons averaging 8·58 dwt., of which amount 170,896 tons averaging 8·56 dwt. was developed during the year. The directors have been unremitting in their efforts to induce the government to build a railway from the mine to Dunkwa, but after a flying survey had been made the government declined to proceed. The company is therefore about to build a road 78 miles long, suited to heavy haulage, at an expenditure of £20,000. It is also necessary to improve the plant and provide additional machinery. The company has some uncalled capital which will probably be sufficient for the purpose. The nominal issued capital is 220,897 shares of £1 each carrying a liability of 3s. per share, which represents approximately £30,000. There is also a debenture debt of £99,460.

Hingston & Clitters.—This company was formed in 1908 as a reconstruction of Clitters United. The mines are old tin properties containing wolfram and arsenical and cupriferous pyrite and they were reopened in 1900 by the Allen-Schiff group. A modern dressing plant, which has the distinction of being the first to separate the tin and wolfram magnetically, was provided. The unfortunate part of the business was that the plant was erected at the Clitters instead of the Hingston mine, for the best ore is found at the latter and it has to be transported more than a mile to the mill. Also the underground development was neglected and the mill erected before any reserve was proved. The old shafts which were crooked and in bad condition were used instead of a new one being sunk. Modern ideas were applied to the metallurgy and not to the mining. In the course of a few years the control passed to the Schiffs, Mr. Allen retiring. In 1908 the crisis came, for unearned dividends were paid, and the operations for 1907 ended in a serious loss. In addition the Hingston mine was flooded and there was no money available for additional pumps. The control then changed hands and Mr. Allen once more came forward to pro-

vide funds on the reconstruction in 1908. Electric pumps were bought and the Hingston mine unwatered; the Clitters had never been worked below adit. By the time the mine was put in order the funds were exhausted. The report for the year 1909 now issued is gloomy reading. R. T. Moore of Glasgow examined the Hingston mine, and reports that about 15,000 tons of ore is in the mine; he recommends further developments at points specified, at an expenditure of £10,000 If the results are satisfactory he advises the removal of the mill to Hingston at a cost of £5000 and the provision of a further £10,000 as working capital. He reports the plant to be in excellent condition; it consists of 25 California stamps of 1050 lb. each, 9 Buss tables, 10 Frue vanners, roaster, magnetic separator, and an Elmore vacuum plant for removing pyrite. At the present time it seems impossible to raise any more funds; one drawback is the existence of £18,800 of debentures the interest on which is accumulating dangerously. The company makes a small profit by treating tin-wolfram-pyrite concentrates bought in the market from all parts of the world, but as this class of business requires ready cash the operations are cramped.

Dolcoath.—The report of the Dolcoath tin mine, Cornwall, for the half-year ended June 30 shows that a profit of £13,018 has been made, but no dividend is being distributed, as money is required for the equipment of the new main shaft. During the six months 47,279 long tons of ore was mined, and 853 tons of concentrate was produced. The yield was 40·4 lb. per ton, and the receipts £75,639. Of the production 772 tons sold at £91 per ton, and 81 tons of lower grade slime sold for £66 per ton. Sale of copper ore and interest brought the total receipts to £77,372. The cost was £59,304 and lord's royalty £5049, leaving a profit as recorded above of £13,018. Comparing these figures with those of the two previous half-years, the amount of ore crushed is slightly greater but the yield appreciably smaller. During the first half of 1909, the yield was 1000 tons or 49 lb. per ton, and during the second half 904 tons or 42 lb. per ton. The average price obtained has however been greater so that the receipts and the profits are nearly the same as before. The expenditure on capital account during the half-year was £11,762 of which £10,867 was spent on the new main shaft. The total expenditure of capital obtained by the sale of shares since the formation of the company is £124,731 of which the new shaft accounts for £101,230. The company has approximately £33,000 of capital left in hand. The manager R. Arthur Thomas reports that on May 12 sinking was completed at the new shaft, when the bottom of the sump reached 3300 ft. vertical from the surface. Cross-cuts were then started in each direction. The main lode is 150 ft. south of the bottom of the shaft. Connection between the new shaft and the workings had six months before been made by a cross-cut at 2940 ft., and the ventilation of the mine was greatly improved thereby. The Killas shaft has been put in order and a skip road provided. At this part of the mine copper-tin ore is found and it is intended to start mining it when more development work has been done. The company has had an Elmore vacuum plant on the spot for some years waiting for this ore to be mined. In the Stray Park section of the mine there are large quantities of zinc-copper ore, and investigations and trials have recently been made in connection with it. Sixty of the old Cornish stamps are now being dismantled to make room for 12 new Holman air-cushion or 'pneumatic' stamps. These will be driven electrically and 6 of them should be ready for work at Christmas. Additional dressing plant is also being erected. The amount of development work done during the half-year was 2568 ft. In Cornish mines the fashion for giving exact figures for ore reserves has never been adopted. The lodes vary so much that such figures would be of no value. But at Dolcoath there must be a great number of working points where there are plentiful reserves of ascertained value, for the management is able to bring to surface almost any grade of ore to meet requirements. Looking through past records it becomes clear that low-grade ore is treated when metal prices are high, and vice-versa; these circumstances could not be accidental. In fact it is Mr. Thomas's boast that whatever the price of tin Dolcoath always makes a profit.

Botallack Mines.—The report for the year ended March 31 shows that work at Botallack is still centred on the reopening the mine, and on milling the old dumps. The present company was formed in November 1906, when the Allen-Meyerstein group found the necessary capital. During the year the progress of sinking the new main shaft, Allen's, was hindered by the men refusing to work below the 70 fm. level owing to the danger of possible flooding from adjacent workings. Steps were therefore taken to drain the Crown property where water was known to exist at the 70 fm. level, and pumping is now being done concurrently at the Allen and Crown shafts. In a cross-cut at the 70 fm. level a new lode 2 ft. wide and assaying 49 lb. of black tin per ton was struck in Allen's shaft, and it is intended to cross-cut at the 90 fm. level with a view of testing its continuance. Recently a contract has been made with a French firm for the supply of all pitchblende found in the mine during the next three years, and systematic search is being made in the Wheal Edward section. It is stated that the samples of pitchblende sent for examination at the Curie laboratory in Paris showed an unusually high radio-activity. The 20-stamp mill working mostly on dump ore produced 127 tons of concentrate which sold for £10,045. The mining and administration expenses absorbed £16,544, so that there was a loss of over £6000. During the year additional capital was required, and 100,000 'A' shares of 5s. each were offered to shareholders; 65,943 were sold and 6d. per share called up. These shares will receive 5% of the tin sales out of the divisible profits, and half of the profits of the company. The other issued share capital consists of £100,000 in ordinary shares, and in addition there are £4787 income bonds and loans of £20,689. During the previous year there was an adverse balance of £3945, so that the balance to debit of profit and loss is £10,103. During the year Bainbridge, Seymour & Co. resigned their position as consulting engineers, and were succeeded by Pettit and Poore; A. B. Climas is now manager, following W. R. Thomas.

Carn Brea & Tincroft.—The report for the half-year ended June 30 shows that this old Cornish company is in a critical position owing to want of capital. For many years the ore has been too poor to yield substantial profits, let alone provide funds for expansion and development. For some time it has been acknowledged that a liberal supply of new capital has been required, but the necessary steps to meet the situation have been postponed owing to the inauspicious circumstances connected with Cornish mining. In addition, the discoveries of higher grade ore a year ago enabled the company to increase its output considerably, and the directors hoped thereby to weather the storm for the time being. However, the grade has once more fallen and the situation becomes acute. To have an independent opinion of the position of the property and its prospects, the directors asked R. Arthur

Thomas, of Dolcoath, to make a thorough examination. His report is appended to the directors' report for the past half-year now issued.

During the half-year under review 38,797 tons of ore was raised and 491 tons of tin concentrate was produced. During the corresponding period of 1909, 36,825 tons of ore yielded 568 tons of concentrate. The relative produce per ton was 34½ lb. a year ago and 28⅓ lb. during the first half of 1910. The relative amounts realized and the prices per ton were £39,428 and £37,145, and £69 and £75. Sales of other products, arsenic and wolfram, brought the total income to £39,652, and the expenses were £40,157. Lords' royalties amounted to £1422, so that the loss for the half-year was £1927. During the last 10 years, the only time when anything like satisfactory profits were

CORNWALL.

made was during the boom from the middle of 1905 to the middle of 1907 ; before and since then the balance has generally been on the wrong side. Another disadvantage under which the mine labours is the absence of modern dressing plant for removing wolfram ; consequently the price obtained by the sale of concentrate is lower than the average received for Cornish produce. The amount of available cash capital is now less than £5000.

Mr. Thomas's report begins by a review of the history of the property and shows that since 1896, when limited liability was adopted, £132,000 has been raised and spent on the four mines, Carn Brea, North and South Tincroft, and Cook's Kitchen. Of this sum about £100,000 has been spent on development work ; £5000 on new surface plant, and a similar amount on repairs and renewals ; and the remainder has gone in wiping out adverse balances. During the 14 years the developments have amounted to 28,400 ft. or double what was expected would be necessary ; nevertheless it was never possible to keep the development much ahead of mill requirements. The only time when sufficient profits were made to provide a dividend was in 1906 when about £4000 was distributed on the preference shares. The company has the disadvantage of having two lords who own the mineral rights. The Basset estate owns Carn Brea and Cook's Kitchen, and the Clifden estate North and South Tincroft. At the present time the production is distributed thus : 19% from Carn Brea, 43% from South Tincroft, 38% from North Tincroft, and nothing from Cook's Kitchen. Each mine has its separate stamps and dressing floors. The crushing plant consists of old Cornish stamps amounting in all to 244, of which 96 are at Carn Brea, 88 at South Tincroft, and 60 at North Tincroft. As the Carn Brea output is not sufficient to keep more than half its plant in operation, some of the ore from the other two mines is mixed with it. It happens that Carn Brea and South Tincroft ore is fairly clean, but that from North Tincroft carries much wolfram, arsenic, and copper, as well as tin. Mr. Thomas animadverts on the policy of mixing up these ores in treatment and makes the suggestion that in future the North Tincroft ore should be treated separately and a magnetic separator introduced for the removal and recovery of the wolfram as is done at other mines in the neighbourhood. Such an alteration in treatment would not cost more than £2000, and the immediate result would be the production of high-grade concentrate from Carn Brea and South Tincroft, that would command a better price than at present ; the eventual profit to be obtained from the North Tincroft ore cannot be exactly gauged until experiments have been made. Mr. Thomas would also scrap the whole of the stamps and the buddles, if the reserve ore warranted the expense of new plant ; but the mines do not warrant so great an expenditure at surface at present. No work has been done at Cook's Kitchen for some years. The shafts, however, are kept in good state of repair and the water is not allowed to rise

above the 2100 ft. level, chiefly for the benefit of the workings in the other mines. The cost of pumping is heavy, amounting to £15,000 per annum, a figure which does not include any allowance for depreciation or a share of general expenses. Mr. Thomas describes the state of the various workings and comes to the conclusion that the present rate of extraction can be maintained for some time; in fact in South Tincroft there are bodies of ore that could be more extensively worked than at present. He is of opinion that the duty of the stamps could be increased, and more ore treated, and he also points out that a better selection of the ore going to the stamps could be made by more efficient removal of waste. Surveying the position generally, Mr. Thomas hesitates to recommend additional expenditure on development or in the provision of modern surface plant, because such work would require large expenditure and there are no funds available. His advice to keep the ore from the various mines apart and add a magnetic separator at North Tincroft comes within the means of the company and will probably be adopted. In spite of his expression of hesitation, Mr. Thomas's views with regard to the chances of the mine may be taken to be favourable to the large expenditure he indicates and the directors should feel encouraged to look for the necessary capital.

Le Roi.—In our February issue we gave an abstract of the yearly report of this British Columbia gold and copper mine. It was then stated that mining operations were practically suspended and that exploration by diamond-drill and otherwise was being prosecuted on the plan recommended by the consulting engineer, W. A. Carlyle. A circular was issued last month announcing that no new orebody had been discovered and recommending that operations should cease. At the subsequent shareholders' meeting it was agreed to go into voluntary liquidation and gradually realize the assets. A. J. Macmillan was appointed liquidator. Last year the company arranged for a loan of £40,000 locally wherewith to prosecute the exploration work. Of this only £16,000 was spent. Of this amount £5000 has been repaid by the sale of ore, and the company has £8000 in cash or owing from purchasers of ore. It will be seen therefore that the liabilities are small; and there are no debentures or mortgages. The assets consist of the mine, which still contains a large amount of low-grade ore, and has a first-rate equipment of machinery; in addition there is the smelter at Northport which is in good condition. By a gradual and careful realization of these assets, the liquidator should be able to eventually return a substantial amount of capital to shareholders.

Arizona Copper.—The interim report of this Scottish-American company for the half-year ended March 31 shows that during that period 382,683 tons of ore was mined yielding 81,609 tons of concentrate and other smelting products. The amount of bessemer copper produced was 16,322,000 lb., being an extraction of 2·13% of the ore. This copper realized £432,785. The profit of mining was £96,036 and that from the railway £52,900 or a total of £148,937. Out of this £2242 was paid in debenture interest, £12,029 as income tax, and £12,265 as dividend on 'A' preference shares and preference stock. The ordinary shares received £94,993 being at the rate of 25% for the half-year. The directors make the interesting announcement that the copper situation makes the adoption of more economical methods of mining, milling, and smelting imperative. Additional concentrating plant is to be erected and a new shaft is to be sunk. A larger amount has been carried forward this half-year, the figure being £67,400, and part of it will be allocated to meet the extra expenditure. The directors do not explicitly say that additional capital will be raised by the issue of new shares, though this appears to be contemplated. As already mentioned the recovery is 2·13% and a calculation shows the cost of production to be almost exactly 10 cent per pound. By means of extended operations it will be possible to mine lower grade ore at a profit, which at present cannot be done. The directors obviously recognize the fact that the enormous low-grade deposits capable of being worked cheaply will dominate the copper market and inaugurate a long period of low prices.

Esperanza Copper & Sulphur.—This company was formed in 1906 to acquire the Esperanza, Angostura, and other mines in the Huelva district of Spain. The consulting engineer is Robert Addie and the manager is T. D. Lawther. The report for 1909 shows that during the year 47,419 tons was mined at Angostura and 55,730 tons at Esperanza; the former figure is an advance of 15,000 tons over 1908 and the latter is practically the same as before. The whole of the output is shipped to European smelters and chemical works, and the amount actually dispatched during the year was 99,537 tons. The report does not give the sulphur or copper content, nor details of the income and expenditure. The profit for the year was £24,833, out of which £4872 has been paid as debenture interest being 5% on £97,445, and £8769 has been set aside for the redemption of debentures. The ordinary shares receive £16,522 being at the rate of 5%. The ore reserve at Angostura is 179,000 tons and at Esperanza 292,000 tons. The development work during the year has consisted of shaft-sinking and the opening of additional levels, but until the scheme has been completed a year hence, exact figures will not be given. Indications so far show that the additional ore exposed will be at least 600,000 tons. Plans have also been prepared for testing some of the other properties belonging to the company.

Rhodesia Broken Hill.—This company belongs to the Bechuanaland Exploration group and owns a deposit of oxidized zinc-lead ore in northwestern Rhodesia. The ore is found on the surface and in large quantities; at one outcrop 250,000 tons is estimated to contain 26% lead and 22½% zinc, and at another 300,000 tons averages 32% zinc with little lead but with much iron in the form of oxide and carbonate. The difficulty has been to find a process that will treat such ore. Recently an agreement has been made with the owners of the Bradley-Williams process, which was described in our issue of April last, after Johnson & Sons' Smelting Works had made a preliminary test of the process. Briefly the process consists of a modification of the method of removing the zinc by sulphuric acid and precipitating by electrolysis. The directors have decided to try the process in Rhodesia on a small scale, with a view of ascertaining the cost. The question of cost of fuel and transport governs the situation, as well as the success or otherwise from a technological point of view. The report of the company for the year 1909 advises a reconstruction. The new company will have a nominal capital of £350,000 divided into 1,400,000 shares of 5s. each. Of these 500,000 will be allotted in exchange for the same number of £1 shares constituting the capital of the present company, and 125,000 will be offered for subscription to present shareholders in the proportion of 1 to every 4 now held. This issue has been guaranteed and the underwriters have a call at par on an equal number of shares within two years. A new company called the Bradley-Williams Ore Treatment Co. will be formed to acquire the Rhodesian rights to the process, and to

work the ore of the parent company. These propositions were adopted unanimously at the shareholders' meeting held on August 2. As regards the value of the process, Johnson & Sons rightly point out that though it offers more promise than any other, its details have not been elaborated, and in any case its relation to costs in Rhodesia are unknown.

Surprise.—The Surprise gold mine belongs to the Willoughby Rhodesian group. It was floated in London in 1899 and production started in 1901. No dividend has yet been paid. In 1905 and 1906 the production of gold was 18,759 oz. and 20,117 oz. respectively; but subsequently a fault caused the vein to be lost, and the production fell away. After much exploratory work had been done, Walter Currie, the consulting engineer, was able to announce in February last that he had found the vein 350 ft. east of the line of main faulting and at a depth of 500 ft. from the surface. The situation caused by this discovery was considered so encouraging that the directors increased the nominal capital from £200,000 to £300,000 by creating 100,000 new shares of £1 each. Of these 49,742 have been issued at a premium of £1. It was hoped that the development of the vein could be effected through the old main shaft, but on investigation this shaft was found to be in a dangerous condition, so two new shafts 1200 ft. apart are being sunk. In the meantime connection was made from the north shaft and a winze has been sunk on the vein. This winze is now down 52 ft. and has an average value of 14·7 dwt. over 30 in. The yearly report issued by the directors last month covers the year 1909. During that period the 20 stamps crushed 29,643 tons of ore and produced 7504 oz., an extraction of 5 dwt. per ton. The cyanide plant treated 22,631 tons of sand and 7012 tons of slime yielding 2265 oz., and in addition 7542 tons of accumulated sand and slime giving a production of 688 oz. The total yield was worth £44,747. The expenses at the mine were £32,374, and at London and Bulawayo £1839; the allowance for depreciation was £5503. The balance of profit was £6853 which was carried forward making the total credit to profit and loss account £33,434. From this £27,644 has been written off so as to extinguish the development and general outlay account. At the meeting of shareholders following the issue of the report much adverse comment was made with regard to the delay in issuing news of the re-discovery of the vein, a subject to which we have referred in a previous issue. The directors however disclaimed any personal interest in the rise and fall of the shares and in the face of that declaration the matter perforce dropped.

Ferrobamba.—This company was formed in November last to acquire 2255 acres of mineral land in Peru, containing extensive outcrops of copper ore hitherto untouched. The property is situated about 40 miles south of Cuzco, and the altitude is 13,000 ft. above the sea. Access is gained by rail from the port of Mollendo 500 miles to Cuzco and thence 75 miles by mule-track. The property has been divided into five sections, Ferrobamba No. 1, Ferrobamba No. 2, Katanga or Copper Queen, Charcas, and Bonanza. Operations have been chiefly centred on Ferrobamba No. 1. The outcrop is enormous both in length and breadth. The vein matter consists of garnet rock interspersed with bornite and chalcopyrite. Tests on the surface, in a shaft 100 ft. deep, and in an adit 490 ft. long primarily intended for a powder magazine, show that the ore averages 6% copper, 9 grains gold, and 3 oz. silver. At various points the assays are higher, being sometimes 25% copper. The garnet rock is found between hornblende-biotite-granite and limestone and is presumably a metamorphic formation due to the action of the intrusive rock on the limestone. The width of the orebody is great and cannot accurately be determined; in many places the garnet rock extends for a width of 3000 ft. along the surface. During or before the cooling of the intrusive, the garnet rock has been shattered and fissured, and probably enriched deposits will be found along these lines. At the Katanga, surface indications are similar, but little work has been done, and at Charcas an outcrop 2625 ft. long and 328 ft. wide is reported, containing much pyrite as well as copper sulphides.

As regards the economic question, it is probable that direct smelting will be adopted. The copper is too evenly disseminated for hand-picking (in any case an undesirable procedure), and the high specific gravity

Ferrobamba. Outcrop on left 150 ft. high.

of the rock garnet makes water concentration impossible. The rock garnet is however easily fused, so that smelting should present no difficulty. Fuel is expensive, and the attention of the engineers is directed to the plentiful supply of water power in the neighbourhood. The company owns the rights of the Chalhuahuacho river and the rights on the Apurimac river could also be obtained. So great is the volume and fall on these rivers that the engineers estimate that 100,000 h.p. could be obtained for the smelter, railway, etc. Though at so great an altitude the climate is equable and Europeans of normal physical condition find no inconvenience in living there. The snow line is 600 ft. above the mines. Native Indians find it possible to conduct primitive agricultural operations at the same height as the mines, and grow vegetables in patches on terraces on the hillsides.

At a meeting of shareholders held last month it was announced that £5000 additional shares are to be issued at £3 each, in order to provide additional funds for systematic development work.

Mungana (Chillagoe) Mining.—This company owns mines at Mungana, North Queensland, producing an ore consisting of mixed argentiferous copper-lead sulphides and carbonates that cannot be separated by water concentration. The ore is sent for treatment to the smelter of the Chillagoe company which owns a large interest in the Mungana Co. The two mines now worked are the Girofla and the Lady Jane, but most of the production comes from the former the latter having suffered from a fire and a creep. During the year ended March 31, the shipments to the smelter amounted to 26,052 tons of which only 610 tons came from the Lady Jane. The average assay was 16% lead, 5·9% copper, and 12¾ oz. silver, and the yield was 1419 tons lead, 1306 tons copper, and 306,640 oz. silver, the recovery being 79% of the lead, 90% of the copper, and 96½% of the silver. It will be noticed that the yield of lead was poor; this was due to the fact that the ore is not now sent to the lead smelting furnaces first, but direct to the copper furnaces, it being found that the low price of lead did not warrant the double treatment. The net amount received for the ore was £49,148. The cost of mining was £31,329, development £5818, prospecting and diamond-drilling £1770, extra expenses caused by fire and creep at Lady Jane £4964, administration £1896, and depreciation £3098. The balance of profit for the year was £1096 which was carried forward. In addition £2597 was spent on capital account for the purpose of continuing the sinking of the Girofla shaft. The deposits at these mines are difficult to follow and to estimate, as the ore occurs in bunches in limestone. Water is troublesome, often coming with a rush from unsuspected cavities in the rock. Several times the mines have been supposed to be exhausted since work started in 1902, but subsequent driving or sinking has added new leases of life. The Girofla is now down 610 ft., and S. N. Rodda, the manager, is hopeful as to the future.

Broken Hill Block 10.—The half-yearly report now issued covers the period ended March 31. Owing to the coal strike it was not possible to work the mine and mill for more than 10 weeks out of the 26. During that time 32,683 tons of ore yielded 4773 tons of lead concentrate containing 2949 tons lead and 170,289 oz. silver, the percentage of recovery being 38% of the silver and 71·5% of the lead. In addition 27,877 tons of zinc tailing was produced averaging 17⅛% zinc, 4⅓% lead, and 9¼ oz. silver per ton. The amount received from the lead concentrate was £37,228, and the accounts were also credited with £1393, being 1s. per ton on the zinc tailing. The expenses were £38,909 and the extra cost incurred through cessation of operations £4274. In addition £8630 was written off for depreciation, and £458 placed to income-tax account, so that the loss for the year was approximately £11,000. As however the balance in hand at the beginning of the six months was £153,218, it has been possible to continue the payment of dividends, £20,000 being disbursed, being at the rate of 2% on the capital of £1,000,000. The company also has an asset of £88,886 due for zinc tailing sold to the Zinc Corporation and the Amalgamated Zinc (De Bavay's). This amount is being received in monthly and quarterly instalments spread over a number of years. In addition the company has an accumulated stock of unsold zinc tailing amounting to 89,700 tons and this is continually increasing. Seeing that flotation processes have been proved commercially profitable on Broken Hill tailing the directors decided to treat their own. Accordingly four units of Elmore vacuum plant were ordered and were completed last month. This is estimated to treat 800 tons per week, and when it is in working order additional units will be provided to treat the total production of zinc tailing, 2000 tons per week. As regard the mine, development work at Block 10 has not given satisfactory results recently. The 1615 ft. level is not in such high grade ore as was found above. The lode is from 8 to 9 ft. wide, averaging 10 oz. silver, 8% lead, and 5½% zinc, and the rhodonite content is high. The main shaft is to be sunk 100 ft. deeper. The reserve of ore is estimated at 600,000 tons which can be extracted at the rate of 2500 tons per week. At the Southern Lease, a lode 5 ft. wide averaging 9% lead, 5½% zinc, and 1½ oz. silver is being developed. Another property has been bought during the half-year, namely, the South Comstock, at Zeehan, Tasmania, for which £5000 was paid. This contains a complex zinc-lead-silver ore which should be amenable to modern dressing methods. V. F. Stanley Low, the general manager for the company, is now on a tour round the world and his position is temporarily occupied by J. N. F. Armstrong. H. A. Vaudeau has been appointed manager of the South Comstock.

Broken Hill Proprietary.—The cabled report for the half-year ended May 31 shows that the mine is still closed, but that metallurgical work has proceeded actively in spite of some disorganization due to the coal strike. Four lead-smelting furnaces at Port Pirie have been in operation on custom ore and on concentrate derived from the re-treatment of the tailing heaps, and they smelted ore yielding 31,135 tons lead and 2,004,702 oz. silver. At the lead concentrating plant at the mine, several labour-saving devices have been added for the more economical handling of the dump-material, and the re-grinding and concentrating machines have been improved. The lead concentrate goes to Port Pirie for treatment, and the zinc tailing is re-treated by flotation. Three of the ten zinc furnaces are complete and trial distilling has commenced. Roasters for the zinc concentrate are in course of erection. Dwight-Lloyd sintering machines of the wheel type have also been ordered for the treatment of the lead concentrate. During the half-year a profit of £37,864 was made, and £31,083 has been spent on construction work, £19,528 being connected with the zinc furnaces, and £7879 with the zinc concentration plant.

Broken Hill Block 14.—As recorded in our issue for February, work at this mine is nowadays restricted to the extraction of carbonate ore from the old stopes in the upper levels, as the sulphide ore is of too low a grade to be profitable at the present prices of metals. The report for the half-year ended March 31 shows that during that period 12,874 tons of carbonate ore was mined, averaging 32% lead and 16·4 oz. silver. The half-year commenced with a known reserve of only 10,000 tons, and ended with 8000 tons in hand, so that developments during the time have been decidedly satisfactory. Moreover the silver content is higher than during the previous half-year when it was only 10 oz. per ton. The sulphide ore left in the mine amounts to 220,000 tons averaging 12% lead, 9% zinc, and 8½ oz. silver, and it is fairly certain that this reserve determines the life of the mine. The carbonate ore mined during the half-year sold for £30,128; mining costs were £17,345 or 21s. per ton; £3347 was written off for depreciation, and £1500 paid as dividend on £30,000 preference shares. The remaining profit, £9691, was carried forward, and the balance of cash in hand amounts to £87,479. It is interesting to record that a Murex plant has been erected for the concentration of the sulphides; results are now being awaited. The directors have been trying to acquire another property, so far unsuccessfully, though a large number have been examined.

Mount Morgan Gold Mining.—The report for the year ended May 31 shows that the total production of gold during the year was 187,867 oz., and of copper 7062 tons, obtained from 397,228 tons of ore. By chlorinating 124,122 tons of silicious sulphide ore, 57,217 oz. of gold and 499 tons of copper were produced; the blast-furnaces produced 109,363 oz. gold and 6563 tons copper; and 52,917 tons of oxidized ore yielded 12,287 oz. gold. Owing to depletion of the oxidized ore the extraction plant has been finally closed. The yield per ton from the smelting ore was 9·93 dwt. gold and 2·98% copper, as compared with 7·77 dwt. and 2·85% the year before, and the yield from the chlorination plant was 9·19 dwt. gold and 0·4% copper, figures practically the same as before. The report does not give the figure for the amount of copper sold, but the price realized was £60 per ton. The total revenue was £1,079,914 and the expenditure £712,722; in addition £24,706 has been allowed for depreciation of plant, £50,000 has been added to the reserve fund, and £60,000 more has been carried forward than was brought in from last year. The dividends absorbed £150,000. The coal strike in Australia did not inconvenience the mine and smelter, as large stocks of fuel were on hand, but the works of the Electrolytic Refining Co., at Port Kembla, where the Mount Morgan copper is now refined, had to suspend operations for a time. The Boyne valley railway from the mine to Many Peaks was completed last month, and regular supplies of basic ore will in the near future replace the barren ironstone flux hitherto brought from Iron island. The capacity of the plant has been extended by the addition of larger converters, so as to deal with the greater amount of matte that will be produced. The new system of filling old stopes has proved satisfactory and no repetition of the cave of two years ago is expected. Much attention is being given to the question of improving the ventilation of the mine. Analyses of the air have not shown any absolutely dangerous proportion of undesirable gases or dust, but in the aggregate the samples showed that the average air is not up to a sufficiently high standard. To improve matters, a new upcast shaft is being sunk at the northwest end of the workings and will connect with all the levels.

Robinson Deep.—This mine is a 'second deep' being on the dip of the Robinson Central Deep and Ferreira Deep. It is controlled by the Consolidated Gold Fields, and is isolated from others of the same group, being surrounded by Wernher-Beit-Eckstein mines. Operations were started in 1898 with 40 stamps and the equipment now consists of 300 stamps and 5 tube-mills. The report for the year ended March 31 shows that 738,495 tons was raised, and after the removal of 16% waste, 620,350 tons was sent to the stamps. The yield of gold was as follows: from the stamps 119,383 oz., from the tube-mill plates 30,223 oz., by cyaniding sand 46,053 oz., and slime 13,113 oz., total 208,772 oz., an extraction of 6·73 dwt. per ton. The estimated content and the assay of the tailing are not given. The revenue from the sale of gold was £877,056, or 28s. 3d. per ton milled. The working expenses were £542,313 or 17s. 6d. per ton milled, leaving a profit of £334,743, or 10s. 9d. per ton milled. The dividends distributed absorbed £343,000, being at the rate of 35% on the issued capital. The output and profit were smaller than in the preceding year, when the figures were: output £1,092,224, profit £525,222, dividend 42½%. The profit per ton last year, 10s. 9d., compares with

LOADING IRON FLUX FOR MOUNT MORGAN.

17s. 7d. a year ago, and the extraction per ton 6·73 dwt. or 28s. 3d. compares with 8·3 dwt. or 33s. 8d. Last year it was announced that to keep the mill going the average ore would have to be of lower grade, so that the fall in yield and profit was not unanticipated. The reserve of ore on March 31 was estimated at 1,050,000 tons having an average assay of 7·23 dwt. C. D. Leslie, the superintending engineer, reports that this reserve does not include anything in the Main Reef. It is hoped that the ore in the Main Reef can be mined at a profit, but figures will not be given until actual results from the mill are obtained. During the past year stoping-drills were introduced and, at the date of the report, 20% of the ore was mined by them. The labour is not as yet very efficient but the advantage of being able to reduce the stoping width by their use is already apparent. The mine has suffered a good deal lately from scarcity of labour, and during the latter part of the year, the mill was not running full time.

Otavi Mines & Railway.—This company is registered in Berlin and owns mines at Otavi and Tsumeb in German South West Africa. The ore is rich and consists of a mixture of copper and lead sulphides. The higher grade is exported to Germany and the remainder smelted on the spot yielding metallic lead and copper matte. The report for the year ended March 31 shows that in spite of the low price of copper and the increased cost of mining the operations have resulted in a satisfactory profit. The output of ore was 49,500 tons as compared with 44,950 tons a year ago. Of this 33,500 tons was exported averaging 16% copper, 26% lead, and 9 oz. silver per ton. At the smelter 16,000 tons of ore yielded 2940 tons of copper matte averaging 48% copper, 24% lead, and 14 oz. silver, together with 2732 tons of lead. The cost of mining increased from 11s. 6d. a year ago to 25s., a rise accounted for by the fact that the ore comes now from the 2nd and 3rd levels instead of from the open-cut. Rock-drills are now employed, and a system of filling exhausted stopes with limestone has been inaugurated. The expenses of mining were £60,600 and of smelting £68,600; the cost of bringing in supplies and of shipping the ore and products was £136,400, and £35,000 was allowed for depreciation. The income from sales was £411,400, and the profit was £100,360. The railway made a profit of £84,300, and after paying administration charges and interest on debentures, the net profit of the company for the year was £168,000. The ordinary shareholders receive £100,000, being at the rate of 10%, and the deferred shares, of which there are 200,000 of no face value, receive £40,000, being 5s. per share. The company is taking an active part in the direction of the exploration work conducted by the Otavi Exploration Syndicate, a London company financed by English and German firms.

Weardale Lead.—This company has been working lead mines in the Weardale valley in Durham county since 1883. Errington Thompson is the manager. The district is well known as a producer of lead and zinc ores. The country consists of carboniferous limestone and deposits are found in the high ground near the junction of the counties of Durham, Northumberland, and Cumberland. In spite of the low price of lead the company has done well during the year ended June 30. At the Boltsburn mine 3699 tons of lead concentrate was produced and the yield from other mines brought the total to 4216 tons, of which 4199 tons was smelted yielding 3402 tons of lead. The revenue from the sale of lead was £47,596 or £12. 12s. per ton. The veins contain much fluorspar and 8660 tons was recovered and sold for £4207. The total expenses were £33,838 and after adjusting stocks and other items the profit was £14,840. The dividend distributed was £9792 being at the rate of 10%. The shares of which there are 97,919 of £1 each carry a liability of 1s. per share. In order to extinguish this liability a further dividend of £4896 is being distributed and the amount simultaneously called up.

Brazilian Goldfields.—This company was formed in 1901 as the Vista Allegre Gold Mining Estates, which name was changed to the present one at the beginning of 1909. During 1909 three subsidiaries the Brazilian Golden Hill, the Brazilian Development, and the Brazilian Matto Feio were floated to acquire and work properties in the province of Rio Grande do Sul, Brazil. The report for the 15 months ended December 31 describes the development work done at the additional properties adjoining those belonging to the above subsidiaries, and at the meeting of shareholders held in August E. A. Mannheim, of the firm of Andre Griffiths, Mannheim & Co., the consulting engineers, gave more recent information. The properties have been called the Serro Rico and prospecting and development have given encouraging results. Mr. Mannheim is now engaged in ascertaining the best method of working them and of treating the ore and has advised the erection of a small plant to be used for testing purposes. Work was started last year with a capital of £20,000, but as it soon became obvious that more money would be required additional shares were issued and £16,875 provided. The company also owns auriferous river gravel, which is to be investigated thoroughly, and holds a large interest in the Brazilian Golden Hill company.

Tominil (Mexican) Mining.—This company was formed in 1906 to acquire the San Felix silver mine in Tamazula district, Durango, Mexico, from the Tominil Syndicate, which had in turn acquired it through the agency of M. Parry Gosset. The capital on formation was £350,000, of which the syndicate and promoters took £9000 in cash and £240,000 in shares; the syndicate at the same time guaranteed the subscription of £60,000 for working capital. The issued capital then amounted to £300,000. Mr. Gosset was made mine manager and consulting engineer. The mine had been a large producer of silver sulphide containing a few pennyweights of gold per ton, and the former owners had done well by shipping ore to smelters. G. W. Schneider was subsequently appointed manager, and his reports were not quite so favourable as Mr. Gosset's. After two years spent in development, Ernald Richardson, of Swansea, a member of a well known family of ore dealers and smelters, became interested in the company, and he and his friends subscribed £50,000 taking preference shares in satisfaction. Mr. Richardson himself took 36,000 shares and stipulated that he should practically have the control and should nominate his engineer. Accordingly Walter Richardson Francis was appointed and he went out to undertake the erection of surface plant. He built an aerial ropeway to bring the ore to the mill, and he designed a reduction plant consisting of rolls, tube-mills, and Hendryx cyanide extractors. A year ago Mr. Richardson died, and Mr. Francis' engagement as engineer subsequently terminated. The directors then appointed Pearse, Kingston, & Browne as consulting engineers, who selected Selwyn Goldstein as manager. Mr. Gosset and Mr. Schneider both resigned their positions. As the metallurgical plant did not give satisfaction, Gerald Browne, one of the members of the firm of consulting engineers, visited the mine in June. His report was presented to a meeting of shareholders held last month, when a reconstruction scheme was adopted. Mr. Browne's report shows that the crushing rolls do not do the duty expected, owing to the

hardness of the ore, and that the Hendryx cyanide plant takes three days to make satisfactory extraction. He recommends the provision of extra crushers and the modification of the cyanide plant by the addition of Butters filter leaves. Before his visit it had been found that the tube-mill output was not sufficient for the purpose and larger machines are on order. Mr. Browne's description of the ore deposit takes much of the colour out of the promoters' prognostications. The ore is found in brecciated fracture planes in andesite. The average width of the veins is 2 ft., and taking a stoping width of 4 ft., he estimates the content of the ore mined at 55s. per ton. He vouches for only 8762 tons at this figure, which is not one-tenth of the previous estimates. The old dumps he figures to contain 30,000 tons averaging 28s., but states that, judging by the history of the mine, the lower parts, at present unapproachable for sampling purposes, will probably contain richer material. In addition to the ordinary and preference shares already referred to, 25,000 more ordinary shares and £10,000 of debentures have been issued. The resources of the company are exhausted, so the directors have proposed a scheme of reconstruction in order to provide further funds. A new company is to be formed with a capital of £250,000 divided into 500,000 shares of 10s. each. The preference shareholders in the old company will receive 55,000 ordinary shares in exchange for their 50,000 preference shares and the debenture holders take similar bonds from the new company. Holders of ordinary shares will receive one share of 10s. credited 8s. paid in exchange for each £1 share, and on acceptance will be presented with one new share for every five shares held in the old company. The 2s. liability on 325,000 shares will bring £32,500 if all shareholders respond. This amount will provide funds for the alteration in the plant and for the additional development work recommended by the consulting engineers. At the meeting of shareholders, the position of affairs was admitted to be not as hopeful as was originally expected, but the proposals for reconstruction were accepted unanimously.

Treasury Gold.—This is one of the small outcrop mines in the central part of the Rand, and is situated between Geldenhuis and Jumpers. During recent years it has been under Neumann control. Dividends were first paid in 1892. In 1894 and 1895 additional property was acquired and new plant consisting of 40 stamps was erected. At the same time the nominal capital was inflated to £540,000. The life of the mine is limited. The report now published covers the year ended March 31 last. During that period 148,154 tons was mined and, after removing 26% of waste, 109,235 tons was sent to the mill, which now consists of 60 stamps. The average assay of the ore was 6·4 dwt., and just 50% of this was recovered in the mill, the figures being 17,569 oz. or 3·21 dwt. per ton. The cyanide plant treated 82,043 tons of sand assaying 3·47 dwt., extracting 2·83 dwt., and 26,871 tons of slime assaying 1·95 dwt., extracting 1·67 dwt. The total extraction was 5·76 dwt. or 90% of the content. In addition 7341 tons of accumulated slime was treated, averaging 3·54 dwt. and yielding 2·75 dwt. The total recovery of gold was 32,468 oz. worth £135,972, and the expenses were £111,096, leaving £24,896 as balance of profit. Out of this profit £6185 was used for the extinction of the debenture debt and for the payment of interest during the year, and £1382 was spent in clearing a fall of ground and re-timbering. The balance was carried forward. No dividend has been distributed for the last five years. The engineers estimated that on March 31 the reserve blocked out consisted of 201,580 tons averaging 5·68 dwt.; in addition the undeveloped ground is expected to contain 108,459 tons of profitable ore. The life of the mine may therefore be expected to be two years from the present date.

Consolidated Mining & Smelting Co. of Canada.—This company was formed in 1905 to purchase the control of the War Eagle, Centre Star, and St. Eugene mining companies operating the mines of those names in British Columbia. The company also has control of the Rossland Power Co., owns the lease of the Snowshoe mine, and owns and operates the Trail smelter. Of the above-named mines the War Eagle and Centre Star are copper-gold producers at Rossland, and the St. Eugene is a silver-lead mine in East Kootenay. The output controlled by the Consolidated is nearly one quarter of the whole mineral output of British Columbia. The company has issued a statement of work done at the Trail smelter during the year ended June 30; figures relating to the finance will follow later. The ore received at the smelter was 406,684 tons from mines belonging to the company, and 78,773 tons was custom ore. Of the former 194,013 tons came from the Centre Star, 183,311 tons from the Snowshoe, and 19,195 tons from the St. Eugene. The yield during the year was 137,614 oz. gold, 2,162,406 oz. silver, 42,365,816 lb. lead, and 5,974,959 lb. copper. The copper furnaces treated 430,851 tons of ore, and the lead furnaces 56,274 tons.

East Gwanda.—This company was formed in 1905 to consolidate the Geelong, Jessie, Eagle-Vulture, and West Nicholson companies operating in the Gwanda district of Rhodesia. The properties contain gold and copper ores, and the plant is extensive consisting of 110 stamps, a chilean mill, cyanide plant, concentrators, and smelting furnaces. The issued capital is £459,605, and there are £124,500 debentures. In December last £20,000 prior lien bonds were offered in order to obtain further working capital but the issue was not a success. More recently the issue has been underwritten so that the company will in a month or so be provided with funds once more, wherewith to prosecute developments at the Jessie and Valley mines. It is also intended to unwater the West Nicholson mine and proceed with stoping operations there. The position of the company during the past two years has been precarious, as the mines had become depleted of ore reserves.

The reserve of developed ore on December 31 at the Jessie was 10,532 tons averaging 6⅔ dwt., and at the Valley 7651 tons averaging 4½ dwt. At the Olympus there is a very large amount of 3 dwt. ore; this mine has been tributed but the option has now lapsed. During the year 51,087 tons was raised from the Jessie and 29,671 tons from the Valley. At the mill 91,400 tons was crushed and 13,348 oz. gold and 4056 oz. silver recovered. The assay of the mill-ore was 7 dwt. and that of the tailing 3·56 dwt. The tailing was sent to Wilfleys and 3641 tons of concentrate produced containing by assay 5844 oz. gold, 6246 oz. silver, and 109 tons copper. The cyanide plant treated 31,110 tons and recovered 2882 oz. gold and 1360 oz. silver. At the smelting plant the concentrate yielded 374 tons of matte estimated to contain 5410 oz. gold, 6040 oz. silver, and 90 tons copper; of the remaining metal some of the gold was recovered by passing the slag through the battery. The total revenue for the year was £96,875 and the working cost including development redemption £99,221 leaving an excess of expenditure of £2345. Other expenses included £2335 cost of the London office, £7470 interest on debentures, and £12,437 depreciation; with other small items, the loss for the year was £34,884.

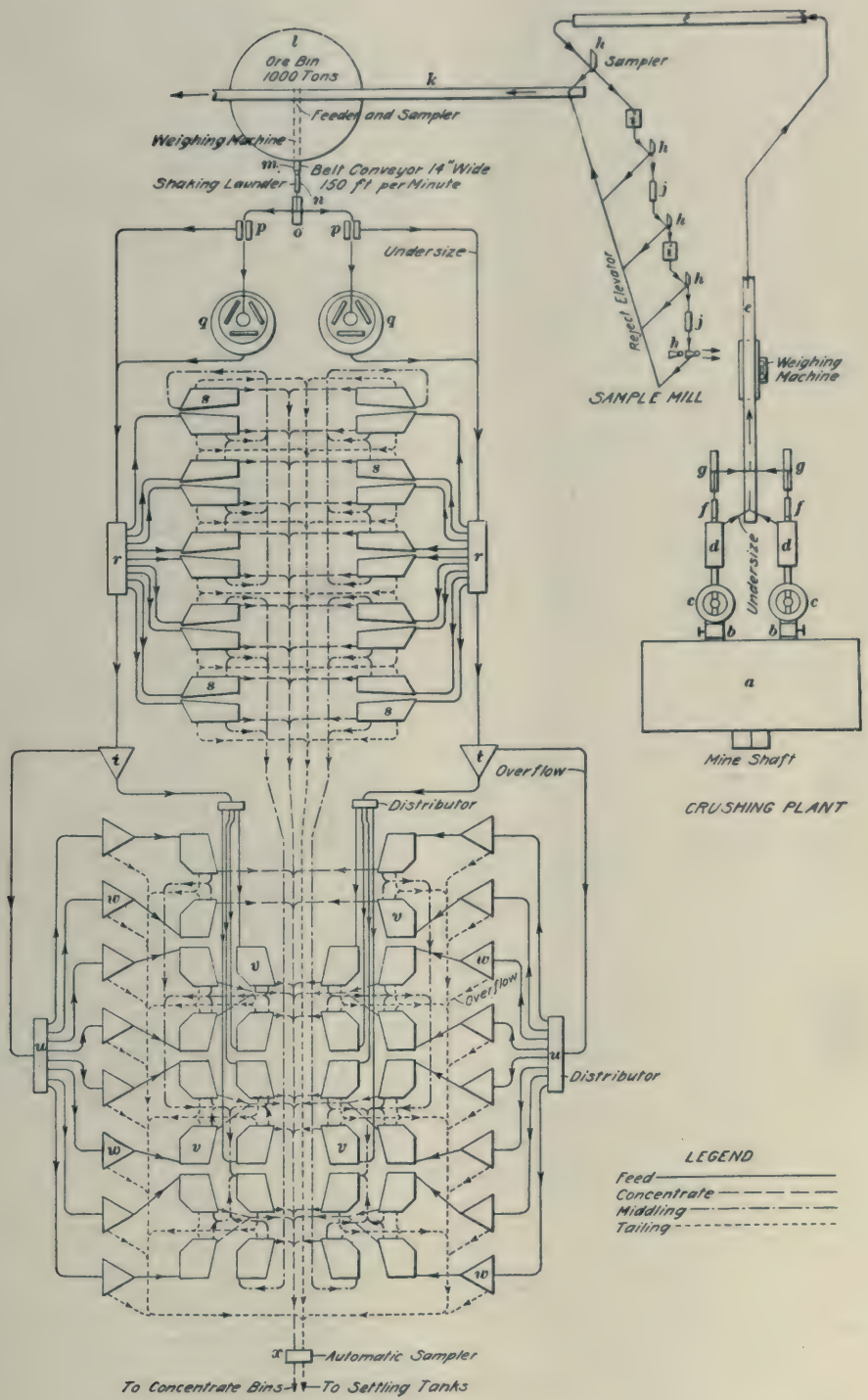
PRÉCIS OF TECHNOLOGY

Iron as Cyanicide.—In the June issue of the *Monthly Journal* of the Chamber of Mines of Western Australia, C. G. Klug manager of the Great Fingall mine gives some interesting details of experiments undertaken at that mine with a view of increasing the extraction from slime and of decreasing the amount of cyanide used. Eighteen months ago when the slime-plant was being remodelled it was found by experiment that good results were obtained by agitation and re-circulation by means of low-pressure compressed air in the presence of lime. When the working plant was built on these lines difficulty was encountered, owing to the large production of ferro-cyanide, resulting in poor extraction and great consumption of cyanide. Expensive experiments were therefore conducted with a view of finding the cause of the formation of ferro-cyanide. The possible sources of iron were carefully examined. Laboratory tests showed that the FeS_2 and Fe_7S_8 in the ore and the FeO in the diorite did not produce much ferro-cyanide, but that the iron due to the abrasion of the shoes and dies in the battery had this effect. As long as the abraded iron is in the metallic state it has no effect on the cyanide. This iron oxidizes by contact with carbonic acid in the presence of water and the formation of the oxide causes the extensive formation of ferro-cyanide on the addition of the cyanide. This activity of the oxide may be due to the hydrogen released during oxidation. In order to get rid of carbonic acid, lime is now added to the mill water, and the abraded iron is thus preserved from oxidation. In the case of accumulated slime that has already been exposed to the action of the carbonic acid of the atmosphere, the practice adopted is to decompose the ferrous salts by aeration in the presence of lime. The fact that the carbonic acid of the atmosphere is the cause of the oxidation of the abraded iron was apparently confirmed by experiments with mechanical agitation in air-tight vessels ; by this method of treatment little ferro-cyanide was formed and a good extraction obtained, and if it had not been for the difficulty of devising a suitable air-tight plant in practice, this system of treatment would have been adopted, Mr. Klug in his paper gives full details of many experiments, together with results and deductions.

Miami Concentrator.—*Mines and Minerals* for August contains a description of the concentrating plant which is now being erected at the Miami copper mine in Arizona. As has already been mentioned in our columns the Miami is a 'disseminated' deposit, and 14 million tons of ore averaging 2·7% has been blocked out. An account of the deposit and the proposed method of working was given in our issue of November last. The concentrator now being built has a capacity of 2000 tons per day. It has been designed by H. Kenyon Burch, who built the Moctezuma concentrator at Nacozari, over the border in Mexico, for the Phelps-Dodge interests. Mr. Burch has recently paid extensive visits to Anaconda, Garfield, Ely, and Cananea to obtain the latest hints on copper concentration. The plant is built on the side of a hill with four main floors, and it is divided into six units each divided into two parts. There are six steel ore-bins, each of which rests on a circular concrete foundation. The ore from the mine is fed automatically from the bin (*a*) to two gyratory crushers (*c*) each having a capacity of 50 tons per hour, and reducing the ore to pass through a 2 in. ring. The ore then goes to revolving screens (*d*) with $\frac{3}{4}$ in. holes. The under-size goes to the belt (*e*), and the over-size is treated in coarse rolls (*g*) and broken to $\frac{1}{2}$ in. The ore from the rolls is delivered to the belt (*e*), which is 30 in. wide and travels at 300 ft. per min. up an incline of 15°. The ore then goes through the mechanical samplers and is subsequently distributed by the belt (*k*) to the six bins. The remainder of the flow-sheet is concerned with one unit only. The ore from the bins is delivered to fine rolls (*o*) which reduce it to $\frac{1}{8}$ in. and work wet. The product is screened at (*p*) to 22-mesh ; the over-size goes to two Chilean mills (*q*), and the under-size to hydraulic classifiers (*r*). The Chilean mills grind to 30-mesh and discharge to the classifiers (*r*). The fine rolls and screens occupy the top floor of the building and the Chilean mills that below. The coarse product from each classifier goes to 9 Deister No. 2 tables (*s*). The tailing from these goes to waste and the middling goes to a tenth table for re-treatment. The fine product from the classifiers goes to conical thickening tanks (*t*), from each of which the underflow goes to 4 Deister slime tables (*v*). The overflow goes to another series of settling tanks (*w*) and then to 8 slime-tables. All these 12 slime-tables make a middling which is re-treated on another table along with the middling from the tenth No. 2 table. The overflow water from the thickening tanks together with the tailing discharge is sent to settling tanks outside the mill and the clear water used over again. The tables (*s*) and the classifiers (*r*) are arranged on the third floor of the building, and the slime tables (*v*) and thickening tanks (*t*) and (*w*) on the fourth or bottom floor. Above these two floors are suspended narrow platforms to support the classifiers and the launders, in order to prevent splashing on the floor. The three products from the tables flow through separate pipes to their respective launders underneath the floor, and vaults are built to accommodate these launders in such a way that they shall always be open to inspection. To give light to the vaults the floors are made of thick glass in iron frame-work. As regards results, it is estimated that the ratio of concentration will be 20 : 1, and that the extraction will be from 75 to 80%. The production will therefore be from 40 to 44 lb. of metal per ton. The concentrate is expected to contain 40% copper, 35% silica, 6% iron, and the balance in sulphur and alumina.

Mercury and Gold in Spain.—*Revista Minera* gives an estimate of the mineral resources of Spain. As regards mercury, it is pointed out that the United States nowadays occupies the first place as a producer. The world's yearly production of the metal is 3600 tons, and that of Spain amounts to 1100 tons, against 1500 tons 15 years ago. Of the other countries producing mercury, Italy, Mexico, Austria, and Russia, the latter alone shows a decreasing output. The mercury resources of Spain are great. The mines of Almaden are the most important, but those of the central Asturian zone, with their large extent of impregnated strata, should have a great future, and in addition there are promising ores in Sierra Nevada, and some in Castellon. Almaden has produced, since the middle of the sixteenth century, 150,000 tons of mercury. The workings have an average depth of 320 metres. Although no attempt has been made to estimate the continuity of the ore in depth, it is assumed that the impregnation extends to a depth of 600 metres, that is, about 300 metres more. On this basis it is calculated that at least an equal quantity of ore is still present in the mine. Adding to this the resources of Asturias and Granada, the Spanish reserve of cinnabar ore is estimated to be at least 2 million tons, of an average value of 250 pesetas per ton.

Spain was, in the time of the Roman occupation,



FLOW-SHEET OF MIAMI CONCENTRATOR.

producing at least 320,000 oz. of gold yearly, but is to-day producing none at all. Nevertheless the country has alluvial deposits at Medulas, the Bajo Vierzo, in Leon, and some in Asturias and Granada. In addition, the beds of many rivers such as the Sil and the Duerna contain appreciable quantities of gold which should repay recovery, the amount exceeding one-third of a gram per cubic metre. The causes of failure of modern attempts at gold mining in Spain may be found, in the first place, in the scarcity of labour, a problem unknown to the Romans, who invariably employed slaves. In addition to this there is no reasonable law harmonizing the conflicting interests of miner and farmer; the former, on attempting to obtain water from the rivers, soon finds himself involved in endless litigation. The question of labour might be solved by the employment of modern machinery, and by working only in the winter months, when water is not wanted for irrigation. It is estimated that the alluvial deposits of the Medulas have an extent of 20 square kilometres, and a depth of more than 50 metres; the amount of gravel is over 1000 million cubic metres, and contains $\frac{1}{3}$ gramme per cubic metre. The Bajo Vierzo deposits contain about 2000 million cubic metres of gravel, and the average gold content may be taken at about the same figure.

Temperature of Formation of Rocks.—F. E. Wright read a paper before the recent annual meeting of the Geological Society of America describing laboratory experiments undertaken with a view to determine the temperatures to which rocks were heated in past ages. The paper is only an indication of what is being attempted and no definite information has yet been obtained by the methods proposed. Sufficient progress has however been made to show that the scheme is feasible. The essential points of the new thermometrical scale are to be determined primarily by the permanent effects which the temperatures have produced on the rocks and the rock components and which are clearly marked even at lower temperatures. The factors which may serve by laboratory experiments to furnish these points are the melting temperatures of stable minerals and of eutectics, inversion temperatures of minerals, temperature limits beyond which monotropic forms cannot exist under different conditions of pressure, stability ranges of enantiotropic forms and of minerals which dissociate or decompose at higher temperatures, and temperatures beyond which certain optical and physical properties are permanently changed. All these factors can be and are being determined by modern laboratory methods and they will undoubtedly be applicable to the study of the formation of rocks.

Cananea.—The geology of this important copper district in the State of Sonora, Mexico, is described by S. F. Emmons in the June issue of *Economic Geology*. A special investigation of the conditions controlling ore deposition was made by Mr. Emmons on behalf of the Cananea Consolidated Copper Co. in 1907. These important copper deposits were mined by the Mexicans, notably by Peschiera, whose widow sold the control to W. C. Greene, an energetic but flamboyant promoter, who, in turn, passed the control, in 1906, to Cole & Ryan. A large amount of copper has been produced and work on a large scale has been conducted for many years, with inadequate profit until the entire plant and system of operations were re-organized recently by L. D. Ricketts.

The local geology is complex. W. H. Weed imputed the origin of the ore to a volcanic vent, Robert T. Hill credited it to a big fault, and now Emmons gives his authority to the view that the enrichment is due to the permeability of the rocks through fracturing and brecciation. The district presents an example of the work done by mineral-bearing waters at high temperatures. At Clifton, in Arizona, ore deposition by hydrothermal waters formed veins in distinct fissures, but at Cananea the character of the rupturing was not such as to form well defined fissures, but a wide belt within which contact metaphorphism has had full play along a series of fracture zones. No less than twelve successive intrusions of igneous rocks have been recognized in the locality; of these only three have affected the limestone, which is impregnated with copper at the contact with porphyry of varying type. In addition, orebodies occur near the contact of two varieties of eruptive rock. Secondary enrichment has modified the deposits variously, concentrating the copper in accordance with the physical conditions due to fracturing. The most marked secondary enrichment has been in the Capote basin, where the fracture zones cross both the sedimentary and igneous rocks. The distribution of ore is too irregular to admit of any simple theory, but the geological investigation has yielded a variety of information of immediate practical importance to those engaged in exploiting the district.

Gold in Madagascar.—J. Kuntz in *Zeitschrift fur Praktische Geologie* for July gives an account of the gold deposits of Madagascar. Madagascar, like the Ural and Klondyke districts, is a land of alluvial gold, the greater part of the metal being obtained by the natives from placers on the shores of the rivers. The bedrock of these placers consists as a rule of old igneous rocks, more or less decomposed and often contains gold to a depth of one foot below the gravel. The placer itself has a depth of a few inches to five feet and consists of quartz pebbles with an upper layer of sand. In some cases on the mountain slopes such placers appear in connection with a limestone which, by the action of erosion, has been worn into hollows. These hollows appear to have acted as natural sluice-boxes, and often contain appreciable quantities of the metal. The value of the deposits vary according to the nature of the ground. The most important gold districts lie on the mountain ranges of the east coast from Diego Saurez in the north to Fort Dauphin in the south, the northern tributaries of the Mananjary being especially noted for their rich alluvial deposits. A few years ago a company was engaged in dredging the sand of some of the gold-bearing rivers on the west coast. The results are not known, but in any case the rivers on the west coast are not so highly auriferous as those on the east. These last, except near the mouths, are in most cases navigable with difficulty, by reason of the waterfalls and the rocky nature of their beds.

As to the question of origin, it has generally been believed that the alluvial gold originates from a series of gold quartz veins or other rich deposits as yet unknown. But the author does not consider it necessary to assume any such source. Searches on the upper Amposary for any lode have been quite unsuccessful. Since alluvial gold is often found in conjunction with old eruptive rocks of the greenstone group, it is quite possible that the metal originates from these. Gold is also found in the gneiss, especially in the embedded quartz, and in such conditions, at Tsimbolovolo, an average of 12 to 15 grammes per ton was obtained over 100 metres, ranging in parts to as much as 200 grammes per ton. The extraction of the gold is almost entirely in the hands of the natives; the French so-called prospectors merely act as intermediaries, buying the gold at 2 francs per gramme in order to sell it at three. Since the French occupation the annual production has risen to over 8,000,000 francs, to which must be

added a large amount which is undoubtedly smuggled out of the country. The apparatus employed by the natives consists merely of a spade and a wooden dish in which the soil is washed, usually with a loss of at least half the gold. The holes dug in order to reach the alluvium are from one to a few metres deep, but at the rich deposits of the Amposary and Mevatanana districts, small shafts are often sunk to a depth of 15 metres; these last are never timbered and soon collapse. In some places, trenches are made in the bedrock; water is introduced and a species of ground sluicing effected; in this way a fine heavy black sand containing magnetite and ilmenite is obtained. From this sand, part of the gold can be separated by washing. The hydraulic method, as employed in America, has been tried at Mevatanana, but without result, the jet of water failing to break down the covering strata sufficiently. In experienced hands, however, there are places where it might be employed with advantage. Finally the author concludes that large companies would find their interests too scattered for economical working; the prospects of such companies lie in dredging the rivers on the east coast, especially near the mouths where the valleys are flatter and transport is less difficult.

waters. The later dolerite dikes have had little or no contact-effect on the porphyry, though these dikes are so numerous that they may have had an important metamorphic influence on the country rock; they may even be responsible for the crystallization of the country rock to form the porphry. The authors express their feeling that the whole question of the origin of the porphyry is still an open one.

The 'old basics' have in places partly absorbed the porphyry, forming felsite, and the true felsite appears in all cases to be intimately associated with these 'old basics.' The most characteristic feature of these rocks is that they form the boundaries of the ore deposits, having arrested the flow of the mineralizing solutions. They are homogeneous and fine grained, and are so tough that some of the later intrusive dikes have been turned out of their courses when their flow came in contact with them. No previous writer has classed these rocks as intrusive, and the usual view was that they are metamorphic slate, as they are much jointed and silicified in places. The authors consider that they furnished the material for several series of dikes and that the shattering action of their intrusion influenced both the original and secondary mineralization.

The authors consider the granites to be the main

OREBODIES AT MOUNT MORGAN.

Geology at Mount Morgan.—At the recent meeting of the Australasian Institute of Mining Engineers held at Mount Morgan, Queensland, J. M. Newman and G. F. Campbell Brown, geologists on the staff of the Mount Morgan Company, read a paper on the geology of the mine. According to the authors, the oldest rocks of the district are quartz-porphyry and felsite. These were intruded by the rocks known as 'old basics' and formerly classed as metamorphic slates. Subsequent intrusions through both the foregoing were made by hornblende granite, and a later set of intrusions were made by numerous dikes of andesite, dolerite, and porphyritic diabase. The authors' quartz-porphyry and felsite are the greywacke and quartzite of previous geologists, notably R. L. Jack and T. A. Rickard. The rocks may be metamorphic, but in their present form the authors consider them felsite and porphyry. All gradations from quartz-felspar-porphyry to felsite have been found. Among their notable features are: (*1*) they contain blebs and crystals of quartz and felspar; (*2*) in parts they resemble silicified tuffs and breccias; (*3*) they contain scattered masses of crystalline limestone; (*4*) in places they are associated with masses of ribbon-jasper in porphyry; (*5*) there is no doubt that the porphyry is one of the rocks which have been replaced by mineralizing solutions to form the orebody. The view contained in (*5*) is supported by the fact that on the western side of the orebody gradations from dense ore to mineralized porphyry are found; also the quartz blebs become smaller and more rounded near the orebody proper, indicating that the quartz has been dissolved by the mineralizing source of the mineralizing solutions. These solutions replaced the porphyry with silica and iron pyrite; gold occurs both in the silica and the pyrite, and copper in the latter. The reasons for this belief are: (*1*) the excessive amount of silica in the replaced body; (*2*) the presence of tin oxide in the oxidized ore; (*3*) all the porphyry near the granite, both north and south of the mine contains about 1 dwt. of gold per ton.

The various dikes are of persistent nature. The andesite, dolerite, and diabase dikes form a complicated network and are often faulted. None of them appear to have had any influence on the orebody, but occasionally native copper has been found in them, having been formed by the action of surface waters.

Sedimentary deposits caused by denudation cover these igneous rocks, and consist of conglomerate, fireclay, and sandstone, and there is a doubtful basal bed of volcanic ash. They are rated as belonging to the lower Mesozoic series. Further denudations subsequently took place, and both the sedimentaries and igneous rocks were cut to form the present watercourses.

The accompanying sketches give a general idea of the orebody and its variations in depth. Much limonite is found in the sandstone at the top of the deposit, but from 50 to 250 ft. from the top there is little trace of oxide of iron. This is due to the leaching of the iron sulphide leaving behind only silica and gold. Thus an auriferous oxidized zone was left, and this was the first part of the orebody to be discovered and worked. At about 300 ft. the 'mundic' ore, containing pyrite, silica, and gold, but with only small amounts of cop-

per, is found. The change to sulphide is sudden, due to the presence of the dikes and floors which regulated the course of the downward waters. The authors consider the ' mundic ' to be the original ore, and believe that the copper content has been removed by descending solutions. In one part of the mine, at the northwestern extremity of the 750 ft. level, the ore is practically in its unaltered original state. It was formerly supposed that there was a sharp line of demarcation between the ' mundic ' at this point and that to the northwest of it, the line of division being the andesite dike, but the authors see no reason to make any distinction between these bodies, accounting for the different copper contents by the greater flow of solutions on one side of the dike than on the other. Below the leached mundic is found an enriched zone of pyrite containing much more copper, the average analysis showing 3½%. The evidence of enrichment is: (*1*) oxides of iron are present in crevices throughout the orebody; (*2*) along the footwall and along dikes, seams up to 2 or 3 inches wide of chalcopyrite are found; stains of bornite are associated with the chalcopyrite and sometimes veins of gypsum; (*3*) in parts of the mine the texture of the ore is that of a granular mass of individual pyrite grains, which were probably formed in cavities caused by leaching; (*4*) down to the lowest levels the country rock is more or less kaolinized and serpentinized. The fact that no coarse gold, in plates or nuggets, has been found goes to prove that the gold concentration was more mechanical than chemical.

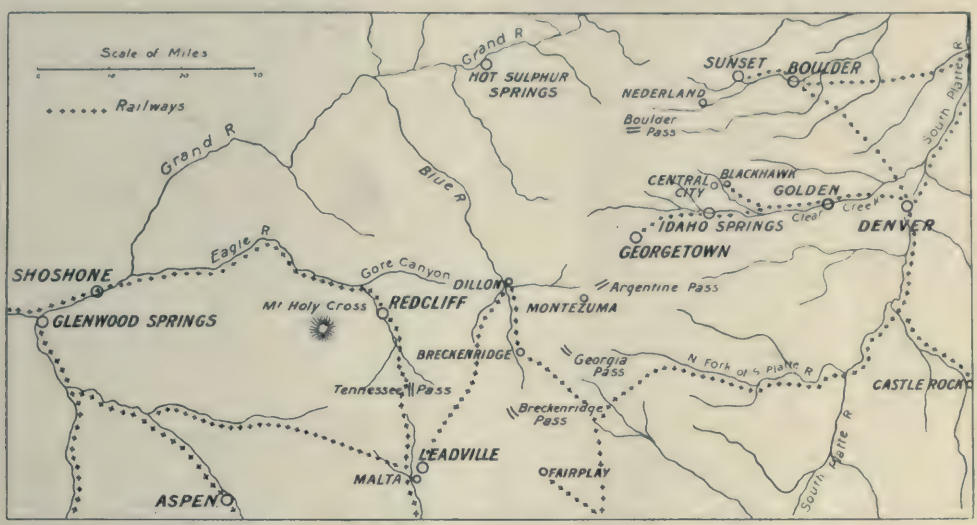
In conclusion the authors state that their present paper is only a preliminary one, and that after further detailed examination microscopically and otherwise they will be prepared to submit fuller information and possibly revise their theories.

Ultimate Source of Ores.—In the July *Bulletin* of the American Institute of Mining Engineers, Charles R. Keyes presents a paper with this title, in which he argues in favour of the theory that many ore deposits are the result of concentration of metallic compounds derived from extra-terrestrial sources. His paper commences with a general review of the various theories, and he divides the primary sources of ore into four classes: (*1*) derivation from sea-water; (*2*) extraction and segregation from igneous rocks of which they originally formed part, by weathering processes; (*3*) production in connection with rock masses in a molten state and separated from them by magmatic secretion or by the expulsion of volatile compounds during cooling of the magma; and (*4*) derivation of metallic particles from extra-terrestrial sources, and their later segregation through the action of surface water. Of these four sources, (*1*) may be dismissed immediately, as sea-water has long been proved to be a distributor rather than a concentrator. The second and third include practically all the modern views on the subject. All these are discussed shortly by Mr. Keyes, and he then proceeds to the more detailed statement of the fourth source. He mentions the theory ascribing the origin of the planets to meteoric agglomeration, put forward by Meyer in 1848, and he quotes Chamberlain who in 1905 calculated the amount of meteoric dust settling upon the globe every year. He gives many instances recorded of accumulations of meteoric matter that has not been quickly disintegrated and absorbed into the earth, such as the bands of dust found in glaciers, and the plentiful collection of meteorites in the arid districts of the west of America. The meteoric dust, being metallic and heavy, gravitates into the earth when the surface is disturbed; and on disintegration or chemical alteration follows the course of waters circulating below the surface. Its subsequent history is probably much the same as that of the minerals derived from rock decay and it is hardly possible to separate these two classes of matter. The author puts forward this theory as a basis for further observation and discussion. He admits that the metals usually associated with meteorites are not representative of the whole range of metals found in the earth, but our knowledge is restricted on this subject simply because so little research has been devoted to it.

Copper - Nickel - Iron Alloys.—*Metallurgical and Chemical Engineering* for August devotes considerable space both editorially and in the contributors' columns to the experiments conducted at Wisconsin University on the physical properties of copper-nickel-iron alloys. One of the papers is by G. A. Roush and was published by the University in 1907, the other is by C. F. Burgess and J. Aston and has only recently appeared. The latter paper deals with alloys of monel metal with iron. Messrs. Burgess and Aston have prosecuted a lengthy research on this subject and have already published papers on nickel-iron and copper-iron alloys. After these researches they undertook experiments with monel metal, which is an alloy produced by direct smelting of the nickel-copper ores by the Canadian Copper Co. at the mines at Sudbury, Ontario. Approximately the constitution of monel metal is three of nickel to one of copper, thus conforming with the tenour of the ore, but the analyses vary and iron and manganese are always present. Messrs. Burgess and Aston started their experiments with pure electrolytic iron, the object being to eliminate carbon entirely. Eventually after the results with pure iron have been obtained further research in connection with commercial iron and steel will be undertaken. Their experiments with monel metal show that the tensile strength and general mechanical properties of alloys of monel metal with pure iron are as of high a class as those of nickel steel. This is important because monel metal is cheaper to produce and cheaper in the market than nickel. The promised investigations on alloys of monel metal with iron containing carbon, that is, commercial iron and steel, will be awaited with interest.

Hydro - Electric Power in Colorado. — *Mining Science* for August 11 contains an account by C. H. Paddock of the new hydro-electric power stations erected by the Central Colorado Power Co. This is an important undertaking and by its means extensive mining districts will be provided with cheap power that have hitherto had to depend on wood fuel or on coal laboriously and expensively hauled up the mountain sides. The estimate is that the power at these mines will cost in future as much as if coal could be delivered for two dollars per ton. The company has three generating stations, two hydro-electric and one steam. The largest is at Shoshone on the Grand river, where part of the river is diverted to a tunnel 12 ft. wide, 18 ft. high, and 2½ miles long. At the generating station turbines are used and the capacity is 10,000 kilowatts. The second station is in Boulder canyon and it has a similar capacity. Here impulse wheels are employed, as the water is at much higher pressure. The water strikes the wheels at a velocity of 350 ft. per second. The water is accumulated in reservoirs and is not part of the flow of the river as at Shoshone. A storage dam has been built at Nederland in the canyon, 177 ft. high, 624 ft. wide, and 120 ft. thick at the base. A buried gravity pipe 36 in. in diameter made of concrete carries the water to a regulating reservoir at Kossler, whence it travels by a steel pipe 9000 ft. long with a drop of 1830 ft. to the generator. The third plant is at Leadville; it is operated by steam and has a capa-

city of 3500 kilowatts. It is in the nature of a reserve or emergency plant. The current from Shoshone and Boulder canyon is distributed at 100,000 volts to distributing stations at Leadville, Dillon, Idaho Springs, Denver, and Boulder, and in the secondary circuits the pressure is 13,000 volts. At Idaho Springs the lines of the company are connected with those of the United Hydro-electric Co., and at Lafayette with those of the steam plant of the Northern Colorado Power Co. This arrangement will be effective in guaranteeing a continuous service. The rates charged are as follows: first 100 hp., $39 per hp. year; next 400 hp., $27; from 500 to 1000 hp., $21; and over 1000 hp., $12 per hp. year. It is expected that before long the whole output will be contracted for, and extensions are contemplated. Plans have already been made for the establishment of a station in Gore canyon, that will produce as much current as the three at present at work.



TRACT COVERED BY THE CENTRAL COLORADO HYDRO-ELECTRIC POWER CO.

Desilverizing Lead at Port Pirie.—John K. Archer gives in the *Australian Mining Standard* for July 27 an account of the Parkes process for desilverizing lead bullion at the metallurgical works of the Broken Hill Proprietary Co. at Port Pirie. The bullion is first heated in two sets of 'softening' reverberatories; in the first set copper is removed, and in the second set where a higher temperature is used the antimony is skimmed off. The softened lead then passes to 'zincing' pans of which there are five sets of two pans each. Four of these sets are in constant use, and the fifth is held in reserve. In each set of two one is working a later stage of the operations than the other. The pans each hold from 35 to 40 tons of bullion. They are semicircular in cross-section, made of cast iron, and heated with coal fires. In pouring the lead into the pan a thick dross forms on the surface; this is skimmed off when the pan is full and returned to the reverberatory copper-separating furnaces. The first addition of zinc is made with the object of removing the gold. The addition consists of 200 lb. of spelter and 50 lb. of zinc recovered from the retorts. After melting and stirring for half an hour with a mechanical stirrer practically all the gold and some of the silver rises to the surface frequently showing bright iridescent colouring. The pan is then allowed to cool until the alloy hardens on the rim. The alloy is removed by means of shallow, perforated, iron ladles, with the assistance of wooden rakes, and thrown into moulds. The bullion on going into the pan assays about 50 oz. silver with variable but small quantities of gold, and after the first 'zincing' 45 oz. silver and only a trace of gold. If the gold content after the first zincing should be over 2 grains of gold per ton, another 'first' zincing will be made with 120 lb. of spelter.

The charge is now prepared for a second zincing for the removal of part of the silver. It is kept hot for two hours and then 700 to 800 lb. of silver-zinc alloy obtained from the third zincing of the previous charge is added to the pan and the contents stirred for half an hour. The pan is then allowed to cool and the floating alloy is removed and separated from the lead through a pneumatically operated press. The alloy is dropped upon an iron cone in order to split it into convenient sizes for retorting. The lead remaining in the pan contains about 25 oz. silver, and after 2½ hours heating a third zincing is done by the addition of 300 lb. of retort zinc and 275 lb. of spelter. After stirring and cooling, the alloy is skimmed off with perforated skimmers and wooden rakes, thrown into moulds and then stacked by the pan for addition in the second zincing of the next charge. The lead now contains as a rule less than ½ oz. silver per ton, but if more than this a further zincing is required, 75 lb. of spelter being added if the content is from 2 to 5 oz., the final content then being only ½ oz. per ton.

With regard to the gold skimming from the first zincing, the content varies from ½ to 8 oz. gold and 70 to 160 oz. silver per ton. It is charged into a reverberatory known as the gold alloy furnace and melted with litharge from the cupels used subsequently. Part of the zinc is here volatilized and part goes into slag. The bullion produced assays 150 to 240 oz. silver and from ½ to 1½ oz. gold. This is charged by hand into a 'special' zincing pan where it is melted and treated with 300 lb. of spelter and the resulting alloy removed by a press. If the assay of the remaining charge is over 2 grains of gold per ton the charge is treated to another zincing reaction; if the resulting alloy is rich enough it is mixed with the alloy from the previous zincing, if not it is added to the charge in the first

special zincing pan. The resulting alloy from these special pans, called the 'special gold alloy,' is retorted and some of the zinc recovered, and 'special gold bullion' produced. The special gold alloy assays from 100 to 350 oz. silver and 1 to 10 oz. gold per ton, and the special gold bullion varies from 800 to 1500 oz. silver and 100 to 300 oz. gold per ton. The special gold bullion is concentrated in the cupels and then goes to the parting plant.

As regards the recovery of the silver, the pressed alloy from the second zincing is retorted and the bullion produced is first concentrated in cupels until it reaches a richness of 16,000 oz. per ton and it is then finished in the drying cupel. Any copper finding its way into the zincing pans is collected in the first zinc skimmings and eventually becomes part of the special gold bullion. It sometimes is found here in considerable quantities and gives trouble in the cupels. If the antimony has not all been removed it gives the lead in the zincing pans an oily appearance and makes the alloy difficult to remove by skimming, and it also hinders the formation of the silver-zinc-lead alloy. A small amount of gold always goes into the silver bullion and the refined silver always assays from 1 to 2 oz. gold to the ton. A special gold dross is obtained by drossing the charge of gold bullion before sending it to the special zincing pan, and is sent to the gold cupel with the special gold bullion; it usually contains a good deal of gold and copper.

Determination of Arsenic.—In the *Engineering and Mining Journal* for August 20, L. L. Krickhaus describes a variation of the method of estimating arsenic in ores, etc., based on the reaction of arsenic and potassium iodide, the novelty being in the use of zinc oxide in the production of sodium arsenate. The advantages claimed are that only one filtration is required and that no exact neutralization such as is required in Richard Pearce's method is necessary. The method consists of taking from ¼ to 1 gramme of the material together with 3 to 4 grammes of a mixture of 4 parts zinc oxide and 1 part normal sodium carbonate, and mixing them in a porcelain capsule. After thorough mixing a layer ¼ in. thick of additional zinc mixture is added. This is heated in a muffle for 15 to 20 minutes at a heat greater than that usually employed in cupellation. After cooling and crushing any lumps that have formed the contents of the capsule are placed in a beaker and 50 cc. of hot water added. Sufficient heat is applied to bring the water to near the boiling point, and to thus dissolve the sodium arsenate. The solution is then filtered, and successive washings of the residue are made with hot water and decanted. The filtrate is reduced from 150 cc. to 50 cc. by boiling, and 50 cc. strong hydrochloric acid added, the sides of the beaker being washed down with the acid. When the solution is cool, 10 cc. of a 20% solution of potassium iodide is added and the mixture stirred. Iodide crystals must not be used as they will not dissolve in strong hydrochloric acid. When the reaction is complete 100 cc. of cold water is added to dissolve the chlorides formed and then the solution is titrated with hyposulphite of soda, using a white surface beneath the beaker. No indicator is necessary as the fading of the yellow iodine colour is quite clear and the end point easily determined.

The solution is standardized with copper as in a copper determination; 0·59 times the copper value gives the arsenic value. It is well to note that the boiling down of the solution after the removal of the zinc and other oxides is necessary, because the potassium iodide reaction is not complete except in strong acid solutions. No arsenic is lost in the boiling down. While heating in the muffle the crucible cover should not be put on, as apparently the air is the oxidizing agent. In Richard Pearce's method it will be remembered that nitre is the oxidizing agent. Titration with hyposulphite could not be used with the nitre method because any undecomposed nitre would react with the potassium iodide. There does not seem to be any danger of loss of arsenic in the high heat of the muffle. Any antimony remains with the zinc and does not interfere with the reaction. Chromium and phosphorus will probably interfere but not more so than in the Pearce method. Manganese colours the solution green, and afterwards pink by the formation of permanganate. It is best to remove the manganese by adding small amounts of alcohol or hydrogen peroxide before filtering off the mixed oxides; the subsequent boiling down to 50 cc. will remove the excess of precipitant.

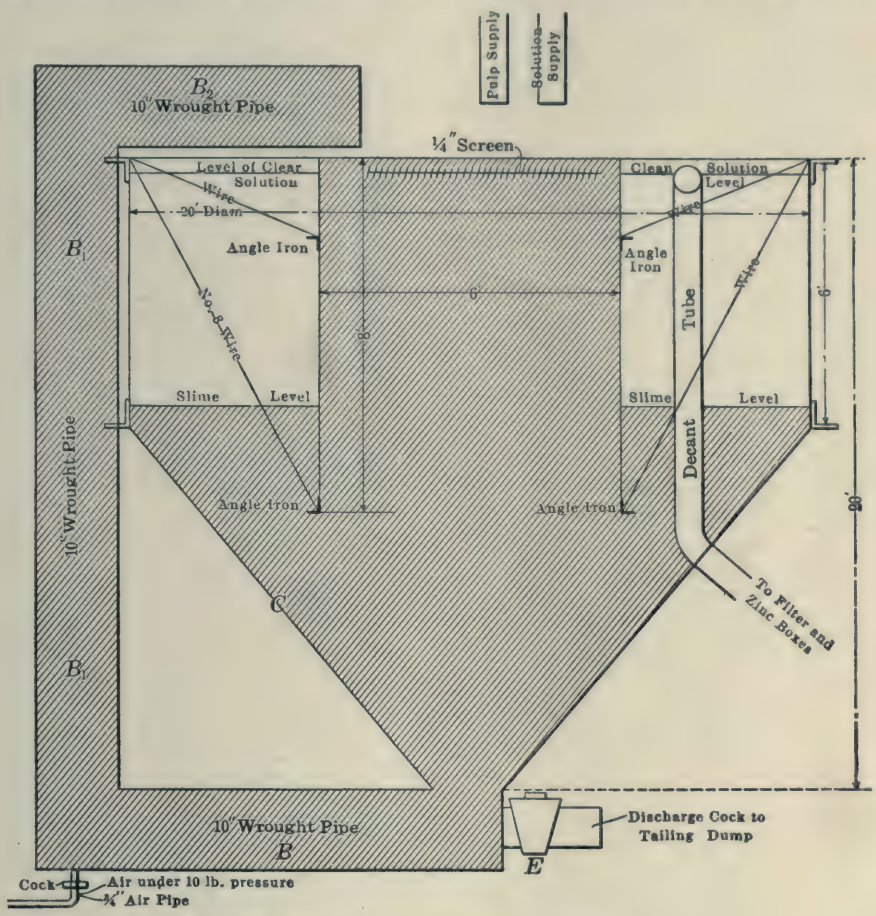
Silica Sponge in Slime Treatment.—In our May issue we quoted a paper by E. G. Spilsbury describing the method of agitating slime by means of air forced through a false bottom made of porous silica. This has since become known as the Just process. In the *Mexican Mining Journal* for August, Chester A. Fulton contributes an article on cyanide practice at Guanajuato, and among other plant described is that of the San Matias custom mill where the Just process has been applied. The San Matias plant contains 40 stamps of 1050 lb. each, crushing in cyanide solution containing 0·09% K Cy; also 8 Wilfleys, 4 Deisters, 2 tube-mills, and cone separators for sand and slime. About 65% of the ore eventually becomes slime, and this was treated until recently in six vats 26 ft. diam. and 12 ft. deep, being agitated by revolving radial arms carrying air-distributing pipes. Six washes were used and the total time of treatment was 32 hours. In December 1909 one of the vats was adapted to the Just process, and the results have been remarkable, for the time occupied by agitation is now only 12 hours, and the cyanide consumption has been decreased.

The silica sponge is made in bricks 2 in. thick and measuring either 12 in. sq., or 12 by 20 in. These bricks are laid upon 4 in. light channel-irons which rest on the bottom of the vat. The bricks are held in place by light iron strips which are bolted to the channel-irons between each row. Air under pressure is admitted into the space below the bricks and it is forced through the interstices into the slime-charge. The pressure of the air is required only to be sufficient to overcome the static head of the charge and the friction of the pipes and bricks. Soon after starting, the charge is covered for a foot with foam. In 12 hours an extraction of from 90 to 95% is effected. The thickness of the pulp is 2½ water to 1 slime, and each charge consists of 60 to 75 tons of pulp. The strength of solution when agitation is commenced is from 0·2 to 0·25% K Cy. The subsequent treatment of the charge is by filtration in Butters plant, and precipitation in zinc-boxes.

Slime Treatment at Santa Natalia.—In our February issue we gave an account of a system of decanting clear solution from slime proposed by A. F. Crosse, of Johannesburg. By this method an internal cylinder was placed within the agitating vat at the top part, and the circulation of the slime induced by an air lift was confined within the space enclosed within the cylinder thus allowing the solution between the cylinder and the wall of the vat to become clear by settlement. That this suggestion has occurred to others is evidenced by the article which is published in the *Engineering and Mining Journal* for August 20, in which Cooper Shapely describes the plant at the Santa Natalia mine, Guanajuato, Mexico. At this mill the ore

is crushed in stamps to 10-mesh, and a cyanide solution (0·08% Na CN) is used in the battery. The pulp after thickening goes to a tube-mill where it is ground sufficiently fine for 80% to go through 200-mesh. The slimed ore is then sent to four vats of the type shown in the accompanying drawing, which is obviously much out of scale. A vat will hold from 30 to 35 tons of dry slime. Referring to the illustration the vat is 20 ft. diam. at the top; the cylindrical part is 6 ft. deep and the conical part 14 ft. At the bottom there is a discharge E for the tailing and an iron pipe B, 10 in. diam. At the other end of the pipe B there is an entry for a jet of air at 10 lb. pressure. This jet causes the pulp to circulate from the vat along the pipes B, B_1, and B_2, and the pulp re-enters the top of the vat within the internally-placed iron cylinder, which is 6 ft. in diameter and 8 ft. deep. Here again we would mention that the drawing is out of proportion. The internal cylinder is held in place by wires which are fixed as shown. It will be seen that the slime occupies the shaded parts, and the solution becomes clarified of solid particles in the space round the internal cylinder. A decantation tube is arranged with its mouth 6 in. below the top of the vat and its height can be adjusted to suit the circumstances. A ¼ in. screen is placed on the top of the internal cylinder in order to remove as much air as possible from the pulp as it pours from B_2 into the vat; otherwise an excess of air is carried down and gains access to the clear solution. The extraction obtained by this plant is 88 to 90% of the gold. An increased extraction could be obtained if the pyrite was removed by concentrators, but this would mean finer crushing in the stamps and a decreased output. Another reason for not concentrating is the expense of marketing the concentrate, it being argued that charges would be as great as the additional recovery.

In operating the vat, it is first filled with clear barren solution to the level of the top of the decanting pipe, and pulp is fed to the inside of the internal cylinder, at the same time the air-lift being set in operation. The filling takes 24 hours, and agitation is maintained for a further 24 hours during which time barren solution is added at the rate of 7 tons per hour. Subsequently the slime is washed with water for another 24 hours. The air-lift is then stopped and the contents allowed to settle for 20 hours. The entry of the discharge-pipe is lowered to within an inch or so of the settled slime and the clear solution decanted. During the whole time of agitation and circulation the clear solution between the internal cylinder and the walls of the vat is gradually removed and sent by the decanting pipe to a filter and then to the zinc-boxes; from here the barren solution goes to distributing tanks from whence it is returned to the vats as required.



SLIME-SETTLING VAT AT SANTA NATALIA.

CURRENT LITERATURE

Moctezuma Copper.—In the *Mining and Scientific Press* for June 18, Courtenay de Kalb describes the Los Pilares copper mine in the Nacozari district, Sonora, Mexico, belonging to Phelps, Dodge & Co.

Mining at Nome.—In the *Mining and Scientific Press* for June 18, W. H. Lanagan describes methods adopted in the Nome district, Alaska, for reclaiming flooded drifts; in the mining operations, water was often unexpectedly found, and means had to be devised for artificially freezing the parts around.

Assay for Gold.—In the *Mining and Scientific Press* for June 18, R. De Luce describes a prospector's method of assaying for gold, depending on the solubility of gold in a solution of potassium iodide containing free iodine.

Teziutlan Smelter.—In the *Engineering and Mining Journal* for July 23, A. Van Zwaluwenburg describes the recently erected copper smelter at Tezuitlan, Mexico. A notable feature is that the movement of all the materials, ore, coke, and water, is effected by gravity.

Slicing System of Mining.—In the *Engineering and Mining Journal* for July 23, M. J. Elsing describes the Mitchell system of mining adopted at the Calumet & Arizona mine. It is an application of the slicing method to the square-set system of stoping.

Refining Bullion.—In the *Electrical World* for June 23, H. J. Slaker describes the modern electrolytic method of refining gold and silver bullion adopted at the United States mints.

Cyanide Practice in Mexico.—The issue of the *Mexican Mining Journal* for August is a special number devoted to articles on the present practice in cyanide extraction in that country.

Fire Extinguishing at Mining Plants.—In the June issue of the *Monthly Journal* of the Chamber of Mines of Western Australia the report of the subcommittee on fire prevention is published. This report contains suggestions for a steam pump service adapted for combating fire in surface plant.

Slime Agitation.—In the June issue of the *Monthly Journal* of the Chamber of Mines of Western Australia, C. G. Klug describes two methods of aeration recently introduced, one at Great Fingall and the other at Kalgoorlie.

Settling Fume.—In the *Mining and Scientific Press* for July 23 there is an article describing the experimental apparatus used at the Calumet & Arizona smelter, near Douglas, Arizona, for mechanically catching fume that will not settle in dust chambers.

Precipitation of Gold by Carbon.—Following up the discussion on the losses of gold due to precipitation by carbonaceous matter, E. H. Croghan read a paper at the May meeting of the Chemical Metallurgical and Mining Society of South Africa describing experiments on the precipitation of gold by carbon contained in the lime used in the cyanide process, this carbon being the unconsumed fuel used in making the lime.

Feeding Tube-Mills.—At the May meeting of the Chemical Metallurgical and Mining Society of South Africa, C. O. Schmitt described a method of feeding tube-mills when the discharge from the cone-classifier is below the centre line of the tube-mill.

Granby Smelter.—The June *Bulletin* of the Canadian Mining Institute contains an article by F.E.Lathe on the Granby copper smelter, British Columbia. There are eight blast-furnaces the size of which has been gradually enlarged until they now measure 44 by 266 inches. The ore comes from the Phœnix mines, contains 1·2 to 1·6% copper, and is self-fluxing.

Copper in Quebec.—In the June *Bulletin* of the Canadian Mining Institute, James Douglas gives an account of copper mining operations fifty years ago in the Inverness and Leeds district, Megantic county, Quebec. The properties were worked by an English company and the reports were made by John Arthur Phillips.

Gold in North Wales.—A. R. Andrew contributes to the *Geological Magazine*, April, May, and June, a paper on the geology of the Dolgelly goldfield, North Wales. He describes the formations and gives a history of the production of gold from this district.

Prevention of Overwinding.—The *Colliery Guardian* for August 19 describes a new apparatus, used at the Hickleton colliery at Rotherham, Yorkshire, for the prevention of overwinding.

Estimation of Nickel and Cobalt.—In the *Western Chemist and Metallurgist* for July C. W. Badgley describes a method of estimating nickel and cobalt in ores.

The Fume Question.—In the August *Bulletin* of the American Institute of Mining Engineers, F. T. Havard gives a historical summary of the methods of saving fume and neutralizing acid gases from smelters.

Chemical Control of Slimes.—H. A. Ashley, in the August *Bulletin* of the American Institute of Mining Engineers, discusses the formation of soluble colloids of clay and of silica by the action of water and of chemicals used in the cyanide process, these colloids interfering with extraction and filtration. He makes suggestions for chemical methods of preventing their formation.

Yampa Smelter.—*Mines and Minerals* for August contains an article by L. A. Palmer on the Yampa copper smelter, Bingham, Utah. A similar article by the same author appeared in the *Mining and Scientific Press* for August 14, 1909.

Mine Haulage.—In *Mines and Minerals* for August, Eugene B. Wilson continues his series of articles on the evolution of mine haulage and deals with wire ropes in mines and aerial tramways.

Converter Practice.—In the *Engineering and Mining Journal* for August 6, Redick R. Moore contributes notes on the use of basic-lined converters for the treatment of leady copper mattes.

Sand-Filling.—At the June meeting of the Chemical, Metallurgical, and Mining Society of South Africa, Edgar Pam described the methods adopted at Village Deep and Ferreira Deep for filling stopes with sand.

Destruction of Cyanide.—It is necessary to remove the cyanide from current tailing before the latter can be used for filling exhausted stopes. James Moir and James Gray read a paper at the June meeting of the Chemical, Metallurgical, and Mining Society of South Africa, describing experiments in connection with the destruction of this cyanide, based on the production of ferrocyanide by means of the addition of ferrous sulphate. H. A. White read a supplementary paper in which he gave reactions for effecting a more real 'destruction,' involving the dissociation of C and N. He described the action of permanganate of potash, aldehydes and ketones, and picrates, applied for this purpose. Mr. White uses the permanganate method at the Simmer & Jack.

Nyasaland.—The *Quarterly Journal* of the Geological Society for May 1910 contains an extensive article on the geology of Nyasaland by A. R. Andrew and T. E. G. Bailey.

BOOKS REVIEWED

PRINCIPLES OF CHEMICAL GEOLOGY.—By James Vincent Elsden. Cloth, 8vo. 230 pages. London: Whittaker & Co. Price 5s. For sale by *The Mining Magazine*.

This is one of the most useful books published during recent years and should be read by everyone interested in the study of the physico-chemical reactions on which the formation of rocks, minerals, and ore deposits is based. In considering the origin of ores and rocks we too often forget that any particular chemical reaction depends on the physical circumstances such as pressure, temperature, and the presence of other elements or compounds. In the new physical chemistry these conditions are studied, but unfortunately most of the writings on the subject are in German. Mr. Elsden has therefore done English readers a great service in presenting this book. It is wisely concise, but contains the necessary references to important articles and publications so that those who wish to pursue the study will find no difficulty in following.

Briefly the modern idea is that the old divisions of solid, liquid, and gas must yield to the division of bodies into crystalline and amorphous. As an example glass and similar amorphous substances are more conveniently counted as liquids of high viscosity, because they possess neither latent heat nor any definite melting point. Similarly the distinction between the gaseous and liquid phase disappears in the neighbourhood of the critical point. On the other hand there is no intermediate stage between the amorphous and crystalline states, and the distinction is sharply defined. The equilibrium between crystalline and amorphous is the basis of the new study of matter, and Mr. Elsden's book treats of this theory as applied to geology.

THE CYANIDE HANDBOOK.—By J.E.Clennell. Cloth, 8vo. 520 pages. New York and London: McGraw-Hill Book Co. Price 21s. For sale by *The Mining Magazine*.

Mr. Clennell's name is so well known in connection with the cyanide process that a book from his pen may at once be accepted as of standard value to the metallurgist, the assayer, and the mining engineer. The whole subject is treated on broad lines although, of course, the chemical portion and that relating to assaying receive more attention than the mechanical processes involved. This feature is a desirable one on account of the number of works which have already been published on the mechanical side of the cyanide process, as distinguished from its chemical aspect.

To those who have followed the cyanide process from the time when it began to be a commercial success on the introduction of the MacArthur-Forrest process, the earlier portions of the work are particularly interesting, and had they been available when the Cassel litigation was in progress, a considerable proportion of the fees which went to expert witnesses might have been more usefully employed. Although apparently one of the few things which were not known to the early Chinese, the solubility of metallic gold in cyanides appears to have been known a hundred years ago, and the existence of the soluble double cyanides of gold and silver, much earlier. The advantage of aëration was definitely referred to as early as 1843 by Prince Bagration, who stated that potassium cyanide must in future be regarded as one of the solvents of gold, although not speaking of it as a commercial process or in connection with the treatment of ore. Faraday and others also employed potassium cyanide as a solvent for gold long before the cyanide process existed as a commercial operation. The description of the chemistry of the cyanide process which the author gives will be of value to the assayer whose duties, although mainly and rightly confined to fairly simple routine work, might well be amplified by research and occasional special tests. Such would assist the cyanide manager in explaining and avoiding the difficulties which hamper his progress, and which are still too largely regarded as matters requiring purely technical rather than scientific knowledge. It is true that, as the cyanide process stands today, it is mainly mechanical, and that its economic aspect claims and receives more from the energy of the mechanical engineer than from the brains of the chemist, but there is still ample room for the latter, and the perusal of the first section of Mr. Clennell's book cannot fail to give food for thought to both.

The chapters on assaying and general analytical processes contain much that is open to criticism, and it is unfortunate that Mr. Clennell, with his special knowledge of the subject, should have so largely quoted from the published and often carelessly worded and ill-considered recommendations of others instead of drawing more from his own experience. Charges suitable for different types of ore are given in elaborate detail, but without sufficient information as to the nature of the ore to be treated; although it is true that Mr. Clennell points out the omission of such detail in many parts of the book, and refers to the fact that the charges recommended may require considerable amendment on account of variation in ore composition. The description of the assay of telluride and selenide ores is particularly incomplete, and like many other portions dealing with special ores, is likely to lead the assayer into thinking that the assays are simpler than is the case. No doubt the author will elaborate and alter these sections in the next edition.

The present criticisms are by no means made in a carping spirit, but only to point out where an excellent book can be made better. Many other little details may be mentioned which should be amplified or modified. The description of the assay of cupels is useless, as the kind of cupel is not mentioned, and the charge recommended is only suitable for the bone ash cupels which have now been so largely superseded by cupels mainly composed of magnesia and requiring an entirely different fluxing charge. Elsewhere in the book, it is mentioned that magnesia cupels are in use, but they are dismissed with the statement that they have been applied with some success, a statement which is peculiarly unfortunate, seeing that they have now practically superseded all other kinds.

The formula given on page 363 for calculating the amount of nitre for the direct assay of pyritic ores, is somewhat formidable in appearance and, although similar formulæ have been published and possibly used, it will probably be the general experience of the assayer that more depends on the man and the temperature than on any preliminary test with a small quantity of ore. Such preliminary assays are of less value than a direct trial assay on the full charge and under working conditions which, if successful, as so often happens, may be used as the assay itself, or, if not exactly the thing required, may generally be taken as a guide in deciding upon the new charge.

It might be desirable to state a little more fully how bromo-cyanide is commonly prepared for large-scale work. Although a method is mentioned incidentally on page 297, and interesting details regarding the properties of the bromides of cyanogen are given on page 57, the matter deserves somewhat more description

from the worker's point of view than it has received.

On page 333, the assay ton (long ton) is given as 32·675 grammes instead of 32·667; probably a printer's error, as the short assay ton is given in the line above, correctly to the third place of decimals. Apparently the figures given in the work for charges, etc., are based on the short ton, but this does not appear to be definitely stated anywhere, although on page 350 and in a few other cases, the author indicates that the short ton is used.

The chapters relating to chemical analysis bears evidence, similar to that on the fire assay, of having received less attention than the earlier or purely chemical portions of the work. They include the analysis of lime, coal, water and most other materials used in connection with the cyanide process and, although requiring amplification are full of useful information such as could only be given by a man thoroughly acquainted with his subject.

In sections 1 and 6 of part IX we have a useful series of formulæ and tables for the cyanide manager and assayer, including some specially valuable notes on the determination of the dry and wet weights of sands, pulp, etc. G. T. H.

NEW PUBLICATIONS

MINES OF AFRICA.—By R. R. Mabson. Cloth, 774 pages, with many maps. London: *The Statist*. Price 21s. For sale by *The Mining Magazine*.

This book is an extension of the author's 'Mines of the Transvaal' usually known as 'M.O.T.,' and now includes Rhodesian and West African mines. The greater part of the book consists of details of each company operating in Africa, arranged alphabetically. In this way it resembles other well-known publications, but in addition a large amount of information is given about each mine, in order that the investor may obtain a clear idea of the assets and prospects. For instance details of ore reserve, cost and profit per ton, probable life calculated from claim area, etc., are given wherever possible. The maps of the Rand and of other districts are also useful. The preface and appendix contain much general information relating to calculations of yield on investments, and of the contents of 'reef' mines.

TABLES FOR THE DETERMINATION OF MINERALS. By Persifor Fraser and A. P. Brown. Pocket size, 125 pages. Philadelphia and London: J. B. Lippincott Co. Price 10s. 6d.

This is the sixth edition of a book well known in America and published originally in 1874. It was founded upon Albin Weisbach's 'Tabellen,' used at Freiberg, but was so much modified that it could not be called a mere translation.

ANALYSIS OF SILICATE AND CARBONATE ROCKS.—Paper, 225 pages. Ill. By W. F. Hillebrand. Washington: The United States Geological Survey.

This is a revised edition of a previous Bulletin by the same author published in 1907, and contains some important changes and modifications. The methods of preparation of the sample have been revised, so that water shall not be absorbed from the air and that oxidization during fine grinding shall be avoided. The effect of fine grinding on the composition of the sample has necessitated changes in the determination of ferrous iron. The chapters on water have been rearranged and that on the determination of titanium rewritten. Additions have been made to the chapters on fluorine and sulphur.

GEOLOGY AND ORE DEPOSITS OF BULLFROG DISTRICT, NEVADA. — By F. L. Ransome, W. H. Emmons, and G. H. Garrey. Paper, 130 pages, with many photographs and maps. Washington: The United States Geological Survey.

This monograph (Bulletin 407) contains a historical account of the Bullfrog district, a description of its geology, and details of the orebodies and the mining operations. Bullfrog is in the desert on the boundary line of California and Nevada, a few miles north of Death valley and 100 miles south of Tonopah. The characteristic rocks of the district are rhyolitic flows of the Tertiary age and these contain the ore deposits; there are other older rocks consisting of highly altered sedimentaries. The most important gold mine in the district is the Montgomery-Shoshone.

ANALYSES OF ROCKS AND MINERALS, MADE BY THE UNITED STATES GEOLOGICAL SURVEY. — Paper covers, 325 pages. Washington: The United States Geological Survey.

This publication is Bulletin 419 of the Survey's series and consists of a record prepared by F. W. Clarke, chief chemist, of the analyses of rocks and minerals made at the laboratory of the Survey between the years 1880 and 1908.

MCKITTRICK-SUNSET OIL REGION. — By Ralph Arnold and H. R. Johnson. Paper, 230 pages, with illustrations and maps. Washington: The United States Geological Survey.

GEOLOGY AND OIL RESOURCES OF THE COALINGA DISTRICT.—Paper, 350 pages, with illustrations and maps. By Ralph Arnold, Robert Anderson, and Irving C. Allen. Washington: The United States Geological Survey.

These two monographs contain full geological and commercial information about important oil-producing districts in California.

WHO'S WHO IN BRITISH ENGINEERING AND KINDRED INDUSTRIES.—Cloth, 8vo. 300 pages. London: The Eastern Press. Price 10s. 6d.

This is a directory enumerating the various manufactures placed on the market by engineering firms.

TRADE CATALOGUES

THE TERRY CORE-DRILL CO., New York, has sent us a pamphlet describing the machine and its application. This drill produces an unusually wide core, and the cutting is done by a cylindrical cutter and chilled-steel shot. Cores as much as 30 in. diam. can be produced. The catalogue gives many examples of its application to the investigation of deposits of all kinds.

J. K. SMIT & ZONEN, Amsterdam, have sent us their pamphlet describing diamonds used for drilling purposes.

THE MUREX MAGNETIC COMPANY has issued a pamphlet describing the Murex concentration process and its applications. From this we extract the following information relating to the results of 5 days' trial on ore at the Cordoba mine in Spain where a plant has been erected. The ore consists of chalcopyrite, chalcocite, and copper oxide, in gangue consisting of partly decomposed diorite. The analysis for copper showed 2·64% in the ore, 16·03% in the concentrate, and 0·226% in the tailing; the extraction was 92·64% and the ratio of concentration 6½ to 1. In these experiments the consumption of oil was 15½ lb. per ton. These figures give the average of the results, but when the ore was sized it was found that the minus 90 material left only 0·07% copper in the tailing, thus showing that the process works particularly well on slime.

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Scientia non habet inimicum nisi ignorantem.

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REVIEW OF MINING

INTRODUCTORY. — The mining markets continue to be depressed by inanition. While the summer holidays are over, the shooting season is open and keeps many out of town. On the top of the after-holiday dulness comes the General Election in South Africa. This has diverted the energy of some of the big speculators and has caused anxiety among small shareholders. Elsewhere we discuss the subject fully.

The comparative lassitude of the summer quarter is reflected in the decreased new issues. Our contemporary *The Economist* states that during the past quarter the fresh capital subscribed aggregated £28,678,300, as compared to £27,600,000 in the corresponding period a year ago, £88,000,000 in the second quarter of this year, and £99,000,000 in the first quarter. For the first nine months of 1910 the new issues absorbed no less than £216,000,000, which is £24,000,000 more than the previous high record. Of the total £92,588,000 went to foreign countries.

The suspense brooding over the Kaffir market has affected the Rhodesian and West African departments. In both of these the decline in gold production has been a further wet blanket. The new trust company failed to galvanize Rhodesian shares, the Cam & Motor issue was a fiasco, and in West Africa the public seems to have lost interest. Even tin shares have relapsed on a recognition of the artificiality of the market quotations for the metal. Meanwhile the political situation in America has intimidated Wall Street so that copper shares have slumped and the talk of a restriction of output has ended in the announcement that the Calumet & Hecla management has reduced its price of copper to 12⅜ cents, which is a tacit recognition of the weakness of the market position. As against these unfavourable factors, the broad foundations for a return of the speculative temper are being laid in the trade prosperity of the United Kingdom and the harvesting of enormous crops in America. Money is being accumulated and it is not going into the ordinary channels of commonplace investment, as is shown by a new low record in Consols. It only needs the provocation of a little satisfactory news or a few real developments to vivify the markets and induce a resumption of activity.

The participation of the public in Rhodesian and other South African efforts to create new counters for gambling has been checked by private issues, big premiums, and scanty information. Several wretched little affairs have been floated, spoiling the taste for genuine enterprise. The good things have been overloaded. The 'ante' has been too big for the 'game' and the public has not had a 'run' for its money. The big houses cannot expect to have it all their own way. Of course, they can eliminate the public and reduce mining speculation to the dead level of a lock-up investment, or they can antagonize the small shareholder until a few big organizers and promoters are left to play the game by themselves, but that would kill the mining market, which is largely dependent on the multiplicity of small holders.

TRANSVAAL. — The August statistics of production were excellent, but they failed to overcome the holiday inertia. The tonnage was 1,834,105 and the yield £2,646,888, which is the highest on record, except December 1908, when the figures were swelled by transfers from the gold reserve. In August the yield was 28s. 3d. per ton, the cost was 17s. 8d., and the profit 10s. 7d. per ton. The total profit was £961,304, as compared with £937,456 in July and £921,136 in June. The magnitude

of the operations on the Modderfontein is gauged by the fact that during the year the reserve of ore has been increased 1,000,000 tons, with a gain of 1 dwt. in the average content, so that the reserve now stands at 2,582,000 tons of 7 dwt. ore. In January the capacity of the milling plant will be 52,500 tons per month. The new vertical shaft is to be circular and it is estimated that from this shaft no less than 8,250,000 tons of ore can be blocked out by June 1913. A new record in shaft-sinking has been made in the Van Ryn Deep mine, 279 ft. being accomplished in one month.

The disappointment over the first crushing of the Bantjes Consolidated was one of the episodes that depressed the market, temporarily, at least. As a matter of fact a low yield is expected from a first crushing, owing to the absorption of gold by amalgamated plates and vats; and in this case the screen samples were poorer than the average ore in the mine. But such little difficulties in starting a new mill would not be serious if frankly faced. The Bantjes returns were remarkable chiefly for the fact that the announcement of the result was preceded by adverse rumours, which affected the market some time before the shareholders heard the facts. Since then the September returns have shown a higher yield and a more satisfactory result all round. A number of members of the London Stock Exchange have petitioned the directors to investigate the belated publication of news from the Kleinfontein and Bantjes mines. It is also announced that the Jumpers and Treasury mines are to be worked on joint account, thus permitting the extraction of the rich pillar of ore at the common boundary.

The labour statistics for September are encouraging, for they show a decrease of only 300 as compared with August, and even this difference is due to the wastage of 1674 at the Premier diamond mine, for the increase at the gold mines amounts to 1400 natives. The output of gold was 646,899 oz. against 649,269; but this decrease is entirely explained by the extra day in August.

RHODESIA.—Again the statistical record is discouraging, for in August the output of gold was only £191,423 as compared to £195,233 in July. Moreover the yield in August is the lowest since February 1908. The shrinkage is mainly debited to the Globe & Phœnix, where extraction is confined to the treatment of residue, pending the completion of repairs to the main shaft. This alone accounts for a loss of £7800 in comparison with July, when the output from the same mine was far below the normal. The only important increases are credited to the Giant and to the Wanderer, but it is satisfactory to note that the number of producers is 16 more than in the preceding month.

On September 27 the Globe & Phœnix mill was re-started, the repairs to the main shaft being completed. The stamps have been idle since June. In November the new plant for treating the antimonial ore is to be available. Thus a handsome production of gold is now assured from this mine, enough at least to sweeten the Rhodesian statistics. On the other hand, the report of the consulting engineer, Mr. H. A. Piper, foreshadows the necessity for sinking another shaft.

WEST AFRICA.—The output of gold for August is officially stated to have been 13,921 ounces, worth £57,713. This is the lowest for any single month since 1905 and compares with 25,104 oz. worth £100,056 in May 1909 and 15,564 oz., worth £70,988, in July of this year. The aggregate decrease in production for the first eight months of 1910 is 34,846 oz. as compared with the same months in 1909, and 67,809 oz. as compared with the corresponding period in 1908. The continued decline is discouraging, even when explained by the cessation of extraction pending development. And on the top of these depressing statistics comes a report such as that of the

Wassau, indicating that the £63,603 spent since this company was reconstructed has failed to put the mine on a dividend basis. The directors have arranged with the Gold Coast Amalgamated Mines to borrow £50,000 at 7%, this loan being repayable at the end of next year.

The Broomassie company has had a little fuss, culminating in an extraordinary general meeting. We note that the withholding of news is one of the charges brought against the directors, but in this case, as far as we can learn, no justification exists for the charge. Accusations that cannot be substantiated only burlesque such real ground for complaint as has existed elsewhere in the case of other companies. The dead level of Broomassie quotations, which have been persistently low, gives no colour to the charge of inside specution, even if we had not the categorical denial and explanation of a chairman known to be an honourable man.

AUSTRALASIA. — The Great Cobar has passed through a crisis the blame for which must be debited in part, at least, to Mr. J. D. Kendall, who was responsible for the design of the smelting plant. He took it for granted that a high-grade matte could be produced at the first smelting in the blast-furnace. An engineer conversant with copper metallurgy ought to have known beforehand that this could not be done at Cobar. The ore is high in iron, and silica and lime have to be added to the charge. It was found practically impossible to produce a matte higher than 28% copper at the first blast. There were also many defects in the construction of the plant. For instance, there was no provision for making the charge uniform. Moreover, the quality of the labour employed in erecting the plant was inferior, and the construction of the settlers, in particular, suffered. The result was that the Great Cobar came very near to liquidation. It has survived, thanks to the courage and financial resources of the Chairman, Mr. Andrew Haes, and to the technical ability of Mr. H. C. Bellinger, the new manager. To Mr. Bellinger the directors accord full credit, for not only did he devise a perfectly satisfactory metallurgical method but he remodelled the plant at a minimum of expense.

From Broken Hill the latest news is that the Zinc Corporation is to use the Minerals Separation process in the extension of plant now under construction. The Elmore vacuum process brought success to the Zinc Corporation after years of failure, and it is interesting to note at this present juncture that the Minerals Separation process was one of those that were tried and rejected in the earlier days. At that time the owners of the process protested against its rejection and complained that the necessary time and facilities were not granted to them for the purpose of proving their claims. Naturally their gratification at the present development is great. The practical engineering details of their plant have, of course, been vastly improved in the meantime and the process stands now as a proved success.

At the Sons of Gwalia the West lode has now been cut on the 10th level at a distance of 117 ft. and proves to carry 4½ ft. of 5 dwt. ore. Other parts of the mine are looking well. In the Great Fingall the winze below the 17th level and at the very bottom of the mine shows 13 ft. of 10 dwt. ore, the length of which remains to be proved. This is at a depth of 2380 ft. on the vein, or 2250 ft. vertical. At the Great Fitzroy the exploratory work in depth is satisfactory as far as it goes, and at surface the remodelling of the plant is proceeding with a view to using the Minerals Separation flotation process.

An important bit of news, given by our Melbourne correspondent, relates to the Mount Lyell company, which is to ship its copper for refining to Port Kembla, in New South Wales, instead of sending it to Baltimore.

Mr. E. H. Liveing's report on the Associated mine is careful to the point of being inconclusive, but it is apparent that the management has made two errors : trying to maintain production by sweetening the output with ore from one particularly rich stope, and estimating blocks of ground on the basis of the evidence given by the backs of cutting-out stopes.

Waihi shareholders are still nervous, although quotations have rallied. It is a great pity that a property rated as one of the few real investments in mining should have been reduced to a speculation for mere lack of definite information concerning recent developments underground.

INDIA.—The reports from Champion Reef show that at the 38th level from the Carmichael shaft the lode is wider than in the level immediately above, being 30 in. wide as compared with 9 in., while the value is about the same, 2¼ oz. per ton ; the outlook is therefore much more cheerful. The developments on the 2600 ft. level at Nundydroog are excellent, for at several points the lode has been proved to be from 2 to 2½ ft. wide, averaging 2 oz. per ton. In other gold mining centres in India the chief item of news is that the plant for the treatment of accumulated graphitic tailing at Kabulgitti, formerly Dharwar Reefs, has once more been started, and the metallurgists are now satisfied that the modified method of treatment will meet requirements.

EGYPTIAN mining, which had a spasmodic spurt a few years ago, has almost been relegated to the dim past from which it briefly emerged, but we are glad to chronicle the promising prospects of at least one English company operating in the land of the Pharaohs. We refer to the Barramia Mining & Exploration Co., which was formed only a year ago, and is now able to announce a dividend of 10%, payable out of a profit of £4008. The output for the year was 583 tons yielding 4544 oz. gold, which is at the rate of over 7½ oz. per ton. Three veins are being exploited to a depth of 130 ft. All that is needed is a little more of the same kind.

MEXICO.—News from the Santa Gertrudis continues satisfactory. On the 18th level the cross-cut has cut the vein, which is 16 ft. wide, of which 8 ft. assays $20 per ton. This is even better than in the corresponding portion of the 17th level. The latter has been run for the full length of the ore, disclosing reserves averaging higher than the estimate made at the time of the purchase. The foundations of the new mill are completed.

Exploratory work in the Esperanza has now reached an extremely interesting stage, for the large block of ground south of the main fault and north of the Ofir boundary is being tested by means of a cross-cut starting from a winze sunk from the ninth level at the north end of the mine and by a winze at the south end now sinking to the eleventh level ; these workings will be connected by a drift about 1500 ft. long. This affords plenty of room for discovery of new orebodies. In the older workings, the general conditions are good, with indications of a large tonnage of fair grade ore to be won from the stopes previously abandoned. Working expenses, including development and depreciation, are down to $5 per ton, allowing a reasonable profit even on low-grade ore.

The Dolores mine, in Chihuahua, was acquired by an Anglo-American company in 1903, the incorporation being effected in Maine. Recently it was taken over by the Mines Company of America, which has now also obtained contained control of the El Rayo. The Dolores and El Rayo are both regarded as good mines which have passed the experimental stage and are now regularly productive.

UNITED STATES.—The Goldfield Consolidated produced 24,170 tons for a yield of $889,968, and a profit for August of $623,415. Rich ore has been found at a depth of 1000 feet in the Clermont workings. The August

output of copper at both the Utah Copper and Nevada Consolidated mines decreased 14%, to 3720 and 2914 short tons, respectively, for the month. The joint decrease amounted to 1148 tons.

The copper figures for September published by the American Copper Producers' Association show a much better statistical position. The production during September was 53,357 tons, as compared with 57,055 tons in August. The domestic deliveries were 28,795 tons as compared with 30,237 tons, the foreign deliveries 33,529 tons as compared with 27,603 tons, and total deliveries 62,324 tons as compared with 57,840 tons. The stocks on October 1 were 66,426 tons as compared with 75,393 tons on September 1. Thus the production has fallen 3698 tons and the stocks 8967 tons.

At the end of the month Wall Street became less miserable and with good reason, for Mr. Roosevelt's endorsement of the Payne tariff marked his refusal to align himself with the insurgent portion of the Republican party and in so much strengthened the chances of the Democrats. We believe that Mr. Roosevelt made a great blunder and played into the hands of the Democrats, who now can, and will, make the tariff the chief issue in the campaign. The high protective tariff is the primal cause of monopoly and political corruption in America.

SOUTH AMERICA.—We publish an article on the Collahuasi copper district in Chile and we note with interest that Señor Don Carlos Gregorio Avalos has reported on the Poderosa mine. Señor Avalos is a Chilean mining engineer of reputation, he was formerly manager of the Huanchaca silver mine, and he has been Minister of Public Works. His estimate of the ore in reserve is 40,000 long tons, as compared to C. H. Macnutt, with 26,000 tons, W. J. Barnett, 20,000 tons, and Robert Hawxhurst, 89,285 tons. But while the first three estimate the contents at an average of 20 to 21½%, the last put it at 24% copper. However, Mr. Hawxhurst's examination was made in May 1909, Mr. Macnutt's in December 1909, Mr. Barnett's in March 1909, and that of Señor Avalos in September 1910. During the interval the production has been at the rate of 2000 tons per month and the Rosario mine has opened up well, increasing the total available reserve of ore. The report of Señor Avalos will give satisfaction to the Chilean shareholders, who retain a large holding.

SIBERIA.—The Russian copper production for the first half of the current year reached 11,328 tons, which is 32% higher than the corresponding period in 1909. The Kyshtim is expected to produce 4500 tons for 1910, and will join the Russian syndicate controlling the domestic market. The Spassky annual report is belated, and for that reason fails to reflect the entire improvement, due to a complete reorganization of operations, followed by successful exploration in depth. Before the end of the year the output will be 300 tons of copper per month. From the Atbasar the news is that prospecting with drills continues to give excellent results, which are now being confirmed by actual mining through shafts. The exposure of numerous bodies of oxidized ore is being supplemented by the further search for sulphide ore, the presence of which bids fair to lesson any metallurgical difficulty.

KOREA.—The plant sent to Kapsan by Messrs. Collbran & Bostwick, through Messrs. Hooper, Speak & Feilding, has now been installed and, constituting as it does the first application of steam machinery in the northeastern portion of Korea, has aroused much interest among the large number of native miners, who have been accustomed only to hand mining. The Kapsan Concession covers an area of 88 by 50 miles and is being developed by an experienced corps of American and Australian technical men under the direction of Mr. A. R. Weigall. We are informed that the Suan mine produced $33,279 in Septem-

ber, from 3100 tons, with a profit of $20,000.

The Oriental Consolidated, the premier gold mining company of Korea, reports a profit of $623,677 for the year ended June 30. The company is working seven mines, of which the Tabowie and the Taracol are the chief producers. The total ore mined was 320,707 tons and the yield $1,434,495. The reserves have been increased during the year and on June 30 were estimated at 838,000 tons containing $3,948,000. Finer grinding is now being adopted in order to increase the extraction, which hitherto has only 18 per cent.

DREDGING. — Among the new dredging ventures is that on the Inambari river, in Peru, mention of which has previously been made by our correspondent at Lima. A report has been made by William Bach, of London, who states that the gravel will average 7s. per cubic yard. The pontoon is now ready for launching and awaits high water in December; it is expected to begin actual digging next April.

The Offin River Gold Estates, operating dredges in West Africa, is able to announce a profit of £13,388 for 1909; this is a decided improvement on previous years. Rights to dredge over 100 miles of river have been acquired. The conditions connected with dredging of the Offin river are not ideal and even now alterations in the plant are found desirable. The company is suffering from scarcity of labour owing to the rival demands of rubber planters. Another adverse circumstance has been the forced cessation of dredging owing to the severe floods.

OIL.—At the end of September it was announced at New York that the Standard Oil and the Asiatic Petroleum companies had cancelled their agreement and that fierce competition would ensue. A week later the Standard Oil published a long statement claiming that the promotion of 70 new companies in Europe had compelled it to enlarge the market for oil by reducing the price, especially in the Far East, where liquid fuel is finding increased adoption. Until lately the world's supply of oil came from the United States, 64%; Russia, 22%; Galicia, 4½%; Roumania, 3%; and Mexico, 1¼%. These proportions are undergoing rapid change. In Mexico the Standard is fighting the Pearson interests and is endangered by successful exploitation on the part of new companies. The Asiatic Petroleum Company, which is the chief obstacle to the monopoly of the Standard, is said to be controlled jointly by the Shell Transport & Trading Co., the Royal Dutch Petroleum Co., and the Rothschilds. The last have big holdings at Baku. Thus the Caucasus, East Indies, and Roumanian oilfields are pitted against the American output. The quarrel has been brought to a head by the sale of motor spirit to American competitors of the Standard. In brief, the Rockefeller domination is threatened. So long as the output of oil outside the Appalachian region in America was insignificant, the Standard had a natural monopoly and used it as a means to control the world markets in refined oil. The extraordinarily productive wells in Texas, California, Baku, and Maikop have enabled competitors to command local markets as against the Standard's efforts to do so on the output of the comparatively poor wells in the older American oilfields. By control of transport and by chicanery of every kind the Standard obtained a tight hold on the retail trade in kerosene, but its power is now being broken, because the increased output of fuel-oil in new regions finds a local market and by treating the kerosene as a by-product the new companies are enabled to enter territories heretofore closed. The policy of the Standard Oil Co. now is to depress the price of oil to a point where it can make favourable contracts. Our San Francisco correspondent sends interesting news concerning the Californian oilfields and we also publish another article on the Mexican oil region.

EDITORIAL

AT the recent meeting of the Australasian Institute of Mining Engineers a resolution was passed recommending the organization of a Federal Geological Survey capable of unifying the mapping and investigation of mining districts in the individual States. It is recognized that the differences of nomenclature and method exhibited by the State Surveys tend to confusion and lessen the scope of the information collected by these scientific bureaus. Therefore a Geological Survey on broad lines, under Federal control, is desired, not to interfere with those now existing, but to systematize their labours and consolidate their results.

AT the El Oro meeting, as in the case of the annual meetings of other enterprises controlled by the Exploration Company, a vote of thanks was passed to the members of the staff, with an individual mention of the chiefs under whom the mining and metallurgical operations are conducted. This is a gracious and an eminently sensible procedure. We hope that when directors fail to initiate such action that shareholders will rise to propose such a vote of thanks, when it is deserved, and also take the trouble to mention the members of the staff by name. It may seem a small matter to those present at the annual meeting, but it is an event of importance to the hard-working technical men who are giving faithful service at a mine in the far wilderness or the distant mountains.

ON October 6 it was announced that the railway had been constructed as far as the Star of the Congo mine. A few days earlier we read in an evening paper that there had been "a considerable jump in Tanganyikas on the rumour that the railway has reached the Congo." One might imagine that "the railway" was a cyclone or a flood, a monoplane or a dirigible balloon, the movements of which were both rapid and erratic. We should have supposed that the date of completion of the railway would be known with some accuracy and that those interested in the Tanganyika enterprise would know how to discount the beneficial effect of the event on share quotations. But this, of course, pre-supposes that the shareholders are kept well informed and that the progress of construction of the railway has been intelligently followed. To our mind the news that ought to make Tanganyikas "jump" would be the announcement that an experienced and competent metallurgist had made a favourable report on the process to be adopted or that a mining engineer of worldwide reputation had expressed an opinion on the successful outcome of this spectacular venture in central Africa.

TRADE continues to expand. According to statistics published by the Board of Trade the imports of the United Kingdom for the first seven months of the current year were valued at £320,241,000 as against £298,021,000 during the corresponding period of last year. At the same time the exports have risen in value from £212,422,000 to £242,974,000. The improvement is greater than that exhibited by other countries, for while in seven months our imports were 22 millions better than in 1909, those of Germany show an increase of only 1 million and those of the United States 18 millions; and the corresponding increase of exports was over 30 millions in England, as against 27 millions in Germany and only 3 millions in the United States. We note with pleasure also that Canadian trade is growing most healthily. All of which argues that supplies

of money ought to be plentiful and that times of lively speculation must come again soon.

SPECULATORS in the shares of oil companies operating in Wyoming have been warned against insecurity of title. This warning takes the form of a letter to Sir Boverton Redwood from Mr. Edwin Hall, the State Geologist of Wyoming. He lays stress on the fact that locations are not valid unless a discovery of mineral has been made on the claims and that the finding of a seepage or oil spring on adjacent claims does not suffice to comply with the law. Apparently the State of Wyoming has been the scene of many swindles and the State Geologist fears that foreign investors may be inveigled by the plausible statements made by irresponsible promoters. He asserts that the genuine discoveries of oil are few and the locating of claims so reckless as to invite his serious criticism as an official connected with the local mining industry in its legitimate phase. Mr. Hall deserves thanks for his action in the matter.

AS the summer wanes we hear of new discoveries in Alaska, especially in that vast interior region where are "streams that run o'er golden mines." In some cases the live water maintains an open channel during the summer but in most cases the seasonal thaw is so restricted as to be negligible in its effect upon the mining of the gold concentrated on bedrock. Thus most of the localities designated by native names and associated with the 'rushes' or 'stampedes' of a nomadic population of prospectors are characterized by shallow deposits of gold-bearing gravel cemented by frost, the mining operations being distributed among small streams meandering in flat valleys tributary to the various rivers to which the several districts owe their name. Thus recently the Innoko, Kuskokwim, Kobuk, and Koyukuk valleys have been successively the scene of excitement due to the finding of productive placers. The Koyukuk is attracting especial attention at this time, for several men have won fortunes there during the present summer, and the gold-bearing area is said to be extensive. This locality is 600 miles up the Koyukuk river from the Yukon itself, which is then followed for 600 miles to its outlet into Bering Sea or ascended for 1500 miles to White Horse, where the railway has its farthest outpost. Alaska is a country of magnificent distances, and of gold resources no less magnificent.

WE note that the Lena Goldfields, a company controlling one of the great gold mines of the world, in Siberia, continues to report its output in the weird terminology of the Russian system of weights and measures, quite incomprehensible to the average man, to whom *funts*, *dolis*, and *zolotnicks* are but the abracadabra of speech. Why not state the output in ounces? Surely the ounce of fine gold is the one significant unit of gold mining. We note that up to September 7 the yield has been 699,198 cubic yards, containing gold to the value of £1,460,806. The output for the season will be fully £1,500,000. This places the Lena Goldfields at the head of all the enterprises exploiting gold-bearing gravel. The next in rank is the Yukon Gold, which this year is expected to have a 'clean up' of about £1,000,000. These two big mines are both operated under sub-arctic conditions, the ground being frozen, so that the gravel is thawed by steam before it can be extracted for washing. The last Lena report has a note stating that "owing to the swelling of gravel stacked on the surface during winter months, the amount washed is larger than the amount mined and hoisted as St. Petersburg advise." From this cryptic statement we infer that there is a discrepancy between the figures issued at St. Petersburg and those transmitted from the mine. An explanation from the consulting engineer would have been satisfactory, for it is

apparent that a technical detail has gone wrong and it is of a kind likely to have serious consequences. The measurement of the rate of exhaustion of an alluvial mine is peculiarly open to error and can be made accurate only by the exercise of great care and the use of perfectly intelligible units.

A SHAREHOLDER in the El Oro Mining company expresses himself as annoyed by the action of the directors in selling the company's holdings in the Mexico Mines of El Oro. He suspects some ulterior design or hidden trouble. The company is not in want of cash; therefore he does not understand the haste to turn the shares into money. If the shares are valuable, why lose the dividends? If the shares are better to sell than to hold, then there must be something wrong with the Mexico mine and he feels anxious on behalf of those who may be the proprietors of that property. Anyhow, something must be wrong; so he thinks. But he forgets one basic fact, namely, that all mining shares, even the shares in the best of mines, are apt to rise to a price beyond their intrinsic merit. There is a time for buying as well as selling. Nay more, the shares bought to be held as an investment may rise so rapidly that the enhancement in speculative value goes far to discount future dividends; then obviously it is well for the investor to become a speculator and turn a 'lock-up' into a 'quick sale.' We are not informed as to the motives of the El Oro directors, but we infer that if they have sold the Mexico holding it is in the interest of the El Oro shareholders and with an accurate knowledge of the prospects of the Mexico mine. What these are has been told frankly and fairly by Mr. R. T. Bayliss himself, by Mr. R. M. Raymond, the consulting engineer, and by Mr. A. F. Main, the resident manager. We know of no better example of the prompt transmission of information and the frank expression of policy than that to which the shareholders in the Mexico Mines of El Oro have been treated. If Mexico shares have been so high as to suggest a profitable sale, it is at least no mystery why the quotation has risen more rapidly than the estimate of ore in reserve. In our monthly review of mining we have referred more than once to the excited market in Paris and to the options taken by our French friends in Mexican mining shares, not the Mexico mine only, but notably the Dos Estrellas and the Carmen. Thus the shareholder who has been writing to the evening papers has made a mountain out of a molehill and a mystery out of moonshine.

CORNWALL has not only been a great school of practical mining but it has also furnished object lessons in economic geology. It is true, in later years we have gone to America, to Norway, or to Austria for the latest notions on a subject of vital interest to those engaged in mining, but from the days of Henwood and Fox, of De la Beche and Le Neve Foster, of Pearce and Collins, we have had good reason to appreciate the fact that the West Country affords examples of a great variety of lode-structure and furnishes plenty of scope for the earnest student of applied geology. Now we learn with pleasure that one of the men long and honourably identified with scientific education and geological investigation in Cornwall is about to publish a volume of observations on this classic mining region. We refer to a book being prepared by Mr. J. H. Collins, who, it will be remembered, from 1890 to 1897, published a series of papers on the 'Ore Deposits of the West of England' in the proceedings of the Royal Institution of Cornwall. For this work Mr. Collins was awarded the Henwood gold medal. Since then he has continued his studies and collected further valuable material all of which will constitute a volume of 600 pages, with appropriate illustrations. We mention the matter in order to invite help for this enterprise, the

cost of which is to be met by subscriptions of 15 shillings per volume. After publication the price will be raised to 21 shillings. Of course, we have no financial interest in the business, either directly or indirectly, and adopt this frank appeal to the profession—and to those interested in the subject—only in the hope of being useful to a good cause.

South African Elections.

Nothing happens in South Africa quite as predicted, and the Federal elections concluded last month are no exception to the rule. The Nationalists, it is true, have a majority, which on paper must be considered large, but it is smaller than was expected, it lacks several familiar names, while any analysis suggests that the position of the new Government will be one of singular complexity and no little difficulty. In no sense can the elections be described as a Nationalist triumph. Of five ministers who went to the poll, three, including the Premier, were defeated, while for nearly a month General Botha, the acknowledged head of the party and the most popular politician in South Africa, was unable to form a ministry of any kind. For days it was an open question whether he or Mr. J. X. Merriman of the Cape would be the first Premier of United South Africa. How harmony was attained can only be surmised, but it is interesting from the standpoints both of the mining industry and Imperial interests to note some of the more obvious causes of a state of things without precedent in South African history. Hitherto, politics in South Africa, so long as they have not diverged from constitutional lines, have been fairly simple. The cleavage between the Dutch farmers and the British townsmen was as much economic as it was racial, the issues were broad and easily understood, and for the most part national prejudice and self-interest coincided in fixing the attitude of parties. The tremendous shattering of old ideas by the war complicated the problem, and it is probable that the union of South Africa has now transformed it altogether. The difficulties of the situation were forcibly illustrated even before the elections began, when Mr. Merriman, the late Cape Premier, declined to serve in any ministry of which he was not the head. In any circumstances the refusal would have been embarrassing. Mr. Merriman's personal unpopularity outside the Cape Colony is widespread, yet he is one of the most potent personalities in South African politics. Shrewd, resourceful, saturnine, *rusé*, he is perhaps the ablest debater in the new parliament, while in sheer intellectuality and culture he stands head and shoulders above the rank and file of South African politicians. He will have a personal following of from eight to ten in the new Union legislature, and he possesses the invaluable gift of stating what are very human prejudices and motives in terms of first principles. Moreover, his administrative record of late years has been excellent. He last came into power in the Cape at a time when the finances of that Colony were depleted, and when only rigid economy and wise direction could have avoided something very like a disaster to the public credit. He saved the situation, and in the view of friend and foe alike he was one of two possible Treasurers-General in the Nationalist ranks. The other was Mr. H. C. Hull, a Johannesburg lawyer, who showed conspicuous ability in General Botha's last administration. Unfortunately for the Nationalists, Mr. Hull sustained a defeat at the hands of Sir George Farrar so stunning that for a time he meditated retiring from public life, and Mr. Merriman's hold on the situation became so strong that it almost seemed at one time as if his accession to power were inevitable.

If all this were a matter of mere intrigue between rival politicians the interest would be trivial, but in fact the trouble lies far deeper. It is true in the main that South Africa is

politically homogeneous, but it is becoming tolerably evident that in the enthusiasm aroused by the Union, the real importance of the inter-colonial jealousies and conflicting interests that lie athwart the somewhat artificial cleavage between Nationalist and Unionist has been temporarily obscured. Mr. Merriman stands for Cape Colony as General Botha stands for the Transvaal, and the fact that property in Pretoria slumped when the latter was defeated by Sir Percy Fitzpatrick suggests a curious commentary on the situation. That General Botha has finally succeeded in keeping his ministry together, and has ousted Mr. Merriman, is a matter of only secondary interest. The long and painful period of uncertainty that elapsed before any ministry whatever could be constituted speaks for itself. It has shown that the Nationalist party, which was supposed to be the lineal descendant of the Afrikander Bond and the inheritor of the old Dutch traditions, is a coalition of diminished prestige, dubious stability, and uncertain future. Dr. Jameson was reported to have said on the eve of the elections that a 'best man Government,' that is, a Government representing the strongest elements of existing parties, would come into power in 1912, and nothing has happened at present to contradict this view. What is abundantly clear is that South African politics are in the melting pot.

Politics and Mining.

The effects of the election in South Africa on the future of the mining industry is a problem that has occasioned anxiety in London as well as at Johannesburg. So far as it is affected by the political situation at all the outlook of the industry may be considered bright. No party now wishes to injure or restrict the industrial activity of the Rand. The old days when it was possible for President Kruger to regard the mining industry as one of several pawns on the political chess-board are gone for ever. General Botha and his colleagues in the late Transvaal administration have the right to point to their past record as proof that the essential interests of mining are safe in their hands, while among the Nationalist ranks are several men like Mr. J. W. S. Langerman, who, as the Transvaal representative of Sir J. B. Robinson, is conversant with and as closely interested in the Rand as Mr. Lionel Phillips or Sir George Farrar. The Unionist opposition, of course, has a distinctively mining tinge. Dr. Jameson, the official leader, is identified both with Rhodesia and De Beers, while among the prominent Transvaal members of the party are many of the makers of the Witwatersrand. The personnel of the Unionists or Progressives is indeed singularly strong, and it is curious to notice that members of the old Reform Committee of 1895 bulk large both in quantity and quality, suggesting that the impulse which brought that ill-starred body into existence was neither capricious nor insincere.

Sir Percy Fitzpatrick, who has covered himself with glory by his successful fight with General Botha, will be remembered on this side chiefly perhaps as the author of 'The Transvaal from Within,' but he played many parts in the exciting life of the 'eighties and early 'nineties. One of the most versatile of men, he has been a transport-rider, who ran various cargoes through the wild country between Delagoa Bay and Barberton, an explorer who accompanied Lord Randolph Churchill in his trip through Mashonaland, a financier who left the firm of Eckstein & Co. to devote himself to public life, a politician who has exercised a greater influence upon events in the Transvaal than even his public record would indicate, and a writer whose contributions to the scanty literature of South Africa have an individual flavour and quality which suggest that in gaining a politician the country has lost a Bret Harte. He has still to gain his spurs as an administrator, but he is on the sunny side of fifty, and his chance will inevitably come.

Sir George Farrar, who is the head of the East Rand Proprietary combination, showed himself a dogged and pertinacious leader of the old Progressive party, and appears to have gained greatly in personal influence of late years. How far he possesses the temperament and outlook that would qualify him to occupy a similar position under the more spacious political conditions which the Union has called into existence, may be doubted, but he is both strong and shrewd, and these are qualities that count, even with democracies.

Other prominent members of the Transvaal group are Mr. Patrick Duncan, the only one of Lord Milner's young men to make a permanent mark in South African public life, Mr. Drummond Chaplin of the Consolidated Goldfields, Sir Thomas Cullinan, of Premier diamond fame, and Sir Aubrey Wools-Sampson, who is something of a mining engineer, something of a financier, and an entirely gallant soldier.

The Unionists have lost one prominent member in Mr. Abe Bailey, and gained an even more conspicuous recruit in Mr. Lionel Phillips. Neither Mr. Bailey nor the party need be commiserated on the former event. The human mind, even that of a millionaire magnate has its limitations, and having regard to the complex web of financial interests woven by Mr. Bailey, it is simply inconceivable that he could have devoted himself to politics without neglecting the fiduciary obligations calling aloud for his attention. The union of the South African colonies seems in a fair way to progress, whether Mr. Bailey is in Pretoria or elsewhere, but there is another amalgamation on this side of the water for which he is more immediately responsible, and which seems not unlikely to make considerable demand upon his energies.

The formal entrance of Mr. Lionel Phillips into politics may easily prove to be an event of importance. As the local head of the premier South African mining firm, he will, of course, speak with unique authority on all matters pertaining to the industry. But his influence goes further. He elected to return to South Africa some three or four years ago at a time when reaction from the unjustified boom that succeeded the war was at its height, and when economic and political conditions on the Rand were little short of chaotic. Distrust between British and Dutch, between labour and capital, between borrower and lender, was the prevailing note. Chinese labour was evidently doomed, although the Rand obstinately declined to recognize it; responsible government was obviously looming, although the average financial magnate regarded it as little short of anarchy; and an absolute readjustment of conditions had become inevitable. The work of Mr. Phillips during this period of transition was invaluable. His services to the mining industry in the days of its need were conspicuously successful, and were recognized on his return to London last year by a representative gathering of South Africans, who toasted him with all the spontaneous enthusiasm of rich men toward one who has helped to make them richer. The interest attaching to Mr. Phillips' recent work in South Africa has not, however, been confined to finance. He appears to have succeeded in a remarkable degree in transcending both the somewhat narrow outlook of his early political years and the bitterness which he, more perhaps than most men, felt at the events succeeding the Jameson raid, which culminated in the war. Less than five years ago he published a book expressive of opinions that must have been intensely repugnant, not only to the Dutch, but to every liberally minded politician of either nationality, and it speaks volumes for his insight that on his return to the Transvaal he was one of the first to realize the altered conditions, to welcome responsible government, and to accustom the population of Johannesburg, with whom his influence was deservedly great, to a broad policy of conciliation and co-operation between

the two races. He has continued to gain in prestige, and advices from Johannesburg describe his election speeches as statesmanlike utterances which have already secured for him a great position in Union politics. Mr. Phillips has travelled far since the days when his first excursion in the political field resulted in his being sentenced to be hanged by the neck until he was dead. Today he must be regarded as one of the most considerable personalities in South African public life, and it would not be easy to predict the limits of his political career.

It will be observed that the mining industry has no need to complain of under-representation in the Federal legislature. Its danger lies rather in another direction. Politics are an engrossing occupation, the appetite for which comes by eating, and there is a risk that the heads of the great mining firms may neglect their business in favour of their political duties. A less obvious but equally real danger is that they may be tempted to seek popularity at the expense of the European interests for which they are trustees. Already the report comes from Johannesburg that a division of that town in which the miner element predominates was won by a gentleman who some time prior to the election conceded certain demands in an important group of companies, with the effect of raising white wages. Possibly the underlying suggestion is false, possibly the whole report has no more substantial basis than a good many other tales circulated in other elections, but the fact that it is circulated serves to illustrate a tendency that might easily become dangerous. These, however, at the worst are minor evils the remedy for which in the last resort can be applied by the shareholders affected.

The outcome of the elections is as favourable to the mining interest as any that could have been expected, and, despite the recent outburst of petulance on the part of the Premier, there is no reason to anticipate any legislative action calculated to injure the industry. A more probable point of attack is presented by the great foreign land companies, which for years have allowed their territories, often extending to many thousands of acres, to lie virtually untouched in the faint hope that unearned increment would one day enable some return to be made to their shareholders. These corporations would do well to put their houses in order, and make at least a plausible pretence of activity without delay. They have few friends or defenders in South Africa, where a new spirit is abroad with regard to all matters relating to land, and any proposal to tax them would encounter relatively little opposition. Of the larger questions that confront the new South Africa, such as the unsolved native problem, which in some sense governs all others, it would be impossible to speak within the limits of this article. The next few years will be of infinite importance to the sub-continent and will probably determine the lines of its social and economic development. It would be idle to affect the belief that the immediate future is in all respects clear; but it is fortunate that among the amorphous parties in the new legislature are many of the best men in the country, and that today no one party can, or does, claim an exclusive interest in the great industry that sustains and dominates the whole economic life of South Africa.

California.

The American elections have aroused interest in Europe, not for sentimental reasons alone, for it has become evident that political movements are so intimately related to industrial activity as to affect financial conditions. Holders of American stock, whether railways or metal securities, have looked apprehensively at the telegrams from New York, not knowing what might be the effect of the fight between insurgent reform and strategic wealth. Moreover, Mr. Roosevelt has enlisted the sympathy of Englishmen particularly, so as to excite a keen interest in his campaign against the corruption that has battened on the

prosperity of the United States. The issues at stake in America are large enough in all conscience, but we wish to draw attention to one concrete example, as furnished by the State of California. This commonwealth, big enough and rich enough to be an empire, is nominally enjoying representative government as a federated member of the Union, but it is now and has been for many years under the thumb of a corrupt bureau organized by the Southern Pacific Railway. The head of this political bureau practically selects the senators and representatives that go to Washington, chooses the Governor and other State officials, distributes the Federal patronage, usurps the power to shape legislation, debauches the courts, and prostitutes the Press of California. This chief of an organized scheme of political piracy is a man of low ideals and mean character, but his personality is of no consequence because he is merely part of a machine, and were he to cease to exist tomorrow his successor would be no better and could be no worse. It is a system, not a man, that tyrannizes over a community nominally free, but actually enslaved. During the last four years an effort has been made to break the power of the Southern Pacific Railway and to punish those who have bribed the municipal officers of San Francisco, who have purchased franchises, collected tolls, terrorized the courts, and turned the Press into a bubonic plague of mendacity and misrepresentation; but the effort has been vain, except in so far as it has enlightened public opinion. Civilization has never been a more abject failure than in California. The malign power of unrestrained greed has nowhere been more pitifully illustrated. Justice has nowhere been so flouted by legal technicalities. To men of character the State has offered no attraction, for to succeed it has been necessary to take orders from a gang of political pirates. Even the public-spirited efforts of a handful of brave men have received scant support, and what support they have received has come not from the leaders of society, the financiers, the bankers, the merchants, and the successful professional men, but rather from the plain people, together with a few of the intellectual leaders of the community. The condition of affairs has been so unutterably bad that much as a man might appreciate the beauty of the land, its natural resources, and its lovely climate, much as he might care for the friends battling against entrenched wrong, he would feel a loss of self-respect in being compelled to live under conditions so debasing and so stultifying. The conditions have been so bad and the prospect of relief so slight that it is with keen delight that we learn of the result of the recent primary election in which Mr. Hiram W. Johnson was nominated as Governor. The election is in November but the nomination means half the battle, as it makes him the regular Republican candidate in a State where regular Republican has heretofore meant plain Southern Pacific. His election will mean the enfranchisement of California and the dawn of a better day. To our friends in California we reach a hand to congratulate them and urge them to omit no endeavour that may bring about a consummation so devoutly to be wished.

Profitable and Unprofitable.

Among the telegraphic mining news we find the statement that the reserve of ore in the Fanti mines, in West Africa, is estimated as follows: "Payable 82,383 tons; value 6·77 dwt. Non-payable, 107,242 tons; value 4·01 dwt." This statement is open to several criticisms. In the first place 'payable' and non-payable' should be 'profitable' and 'unprofitable.' An ore does not pay, it is not paid, nor is it able to pay; even in a colloquial sense an ore that "pays," that is, is rich enough to meet the cost of mining and milling, is not necessarily profitable, for that signifies a yield more than sufficient to defray all expenses of exploitation and treatment. Obviously, in the case of the Fanti mines the total cost is more

than 4 dwt. and less than 6¾ dwt., let us say 5 dwt.; then ore yielding 6·77 dwt. is profitable and ore yielding only 4·01 is unprofitable at the present time. Next we demur to the use of 'value,' for the number of penny-weights of gold in a ton of ore does not express its value, but only states its average content. Again, it is not enough to state the average content, for ore containing 6·77 dwt. might not yield more than 4 dwt., if the metallurgical treatment happened to be ineffective. It is the estimated yield that the shareholder wants to know, not the assay-value; of course, the latter becomes significant if the average percentage of extraction is also given. Finally, we come to the second part of the statement, embodying an estimate of ore unprofitable at this time but presumably expected to yield a profit when operating conditions become more favourable. If the so-called 'non-payable' ore is never to be profitable, it is as absurd to state the tonnage as it would be to give the estimated weight of a neighbouring hill. This brings us to the obvious point, namely, that the managers of the company should explain the distinction between the two classes of ore and the reasons on which they base the expectation of rendering profitable the ore now known to be too poor to meet the cost of extraction. In this, as in other matters pertaining to company affairs, it should be the aim not only to go through the motions of giving information but to be informing.

Kasuto.

This is the name of a mine acquired by a company whose prospectus, with an invitation to subscribe to a capital of £100,000, was issued on September 21. The mine is in West Africa and consists of a number of leases covering deposits supposedly valuable for gold. One of the assets of the property is "fine quartz pebbles," which are to be crushed and are expected to yield enough gold to furnish a profit of £25,000 per annum, in addition to the £10,100 to be won from the "alluvial." This much is stated in the introductory portion of the prospectus. On the face of it the scheme of operation does not commend itself, for the crushing of the pebbles removed from a gravel deposit, with a view to the extraction of gold, is not a process sanctioned by experience. The adoption of such an unusual method requires the endorsement, at least, of engineers known to be specially qualified to direct so radical a departure. Two engineers have examined the Kasuto and abstracts from their reports are published as part of the prospectus. But we are left in the dark concerning their fitness to advise upon the expenditure of large sums of money in mining. Neither of these gentlemen is a member of the Institution of Mining and Metallurgy, nor of the Chemical, Metallurgical, and Mining Society of South Africa, although this fact would not, by any means, be conclusive proof that they were not well qualified as engineers. However, it suggests a doubt, and, in default of personal knowledge concerning their special qualifications it would be more satisfactory to investors in London if their names were on the roll of the Institution, because it would indicate that they were known to be worthy, by training and experience, to be rated among those whom the public is justified in accepting as safe guides in technical affairs. In such a case as this, where an extraordinary technical method is advocated, it would be reassuring if those responsible had a suitable professional background; for the M.E. and C.E. that appears after their names is a nondescript suffix, signifying nothing. Excellent engineers, experienced and capable as any graduate from a school of mines, but devoid of academic training, are known to us, and we are quite willing to believe that men bearing names unprovided with a luminous tail may be, and often are, eminently able to give good advice and to direct important mining operations. But until the reputations of such men are established we

are compelled to look to the indications furnished by the evidence of membership in recognized technical societies. The M.E. and C.E. are without significance unless they stand for an academic degree, for it is obvious that every man, of any sort of training or experience, who is engaged in engineering work, can call himself a civil engineer or a mining engineer, and the terms fail to be accurately descriptive until other people, qualified to judge, unite in conferring the designation. The gentlemen advising the Kasuto company may, or may not, have a technical right to use the M.E. and C.E.; if they have, it would have been well to indicate the grantor of the degree thus signified. Engineers should not masquerade in fancy dress; their own homespun may be good enough.

These criticisms are further justified by the wording of the reports as they appear in the prospectus. Such extracts as have been printed in the daily Press are full of blunders not only disfiguring to a reasoned statement but suggesting deficient knowledge. The quartz 'reefs' according to Mr. A. L. T. Green, M.E., have not "been opened up from a scientific point of view." What is that? It is his "opinion" that "the natives put in these trenches to find out which way the reefs were going." Then the natives were at least more intelligent than the language used to describe their performances. These natives were a knowing sort of people, for "when they got gold, they stood off some distance at a lower level, and fairly honeycombed this level with native shafts." Here again the description appears only to add to the complexity of the plan of operation. Why did the natives sink "native" shafts; this seems a work of supererogation. Mr. Green found it difficult to ascertain the dip of his 'reef,' but he arrived at a conclusion satisfactory to himself: "As the general features of the Gold Mines in West Africa have a tendency to dip towards the east, this should apply on this property." Thus it would appear that the lodes on the Gold Coast exhibit a regrettable bias and their "features" must be strangely askew. As evidence of the contents of the ore we are given the results of assays on two samples of quartz each weighing 1500 grains and of two samples of gravel weighing 8 and 14 pounds respectively. These last were "taken over two miles of deposits." It seems late in the day to criticize such infantile attempts at sampling, for two samples of ore each weighing 4 pounds are only less ridiculous than the sampling of gravel in lots averaging about 10 pounds apiece. Such a procedure is a farce.

Next we come to the report of Mr. E. A. Gillingham, M.E. & C.E., who describes the alluvial deposit as "consisting of black sand, alluvial gold, and fine quartz pebbles, which contain reef gold." We may infer therefore that the "alluvial" gold did not originate from veins and that the gold in the pebbles was derived from 'reefs'—a pseudo-scientific distinction of no consequence to the immediate value of the deposit. But we are told that "this formation gives promise of developing into banket lode." Here is a another technical distinction only bewildering to the persons to whom the report was made. 'Banket' is consolidated alluvium or cemented conglomerate overlaid by sediment now hardened into rock so that it is mined as an interstratified seam, and not as a placer deposit on the surface. It appears that no shaft has been sunk to bedrock, although Mr. Gillingham sank a shaft 45 feet deep on an adjoining property and "the further he went down the richer the return of gold became." This proves too much. But it was enough to cause Mr. Gillingham to say to the Kasuto directors that "a like result is to be anticipated on your property." He recommends the purchase of an "up-to-date washing plant," without specifying details. The alluvial deposit is close to the gold vein and it is inferred therefore that "in past ages the Reef has shed its gold, and owing to the

system of gravitation and to climatic influences, this reef gold has percolated down for generations to these lower levels." We hope the gold may percolate into the pockets of the shareholders, but we have serious doubts. If the gold in the quartz vein has enriched the placer it cannot at the same time have descended to deeper portions of the vein. Here is a good example of confusion between secondary enrichment and primary impoverishment. As a matter of fact the evidence proves nothing beyond the existence of some gold in the detritus near a series of quartz veins, portions of which are also gold-bearing. Mr. Gillingham concludes that "it always follows that when both ['reef' and 'alluvial beds'] are found together, the Reef must go down to a considerable depth." Plainly nonsense. It might as well be argued that the alluvium is enriched by erosion from parts of the vein that are beneath the surface and that have never been subjected to weathering. This kind of geology is like the Kingdom of Heaven "which cometh not by observation." Finally, it is asserted that the hills adjoining these valuable mines are "composed of diorite, quartz, schist, ironstone, porphyry and felspar; and the low lying country of clay and loam." Hills that contain quartz and felspar are as much mineralogical curiosities as—but no more than—plains that can boast of "clay and loam." But even these obvious redundancies would be forgiven if the more practical portion of the work, namely, the sampling, had been properly performed. Mr. Gillingham gives an "assay sheet" on which we find a stupendous array of results: four samples each weighing 1000 grains! In the column elaborately marked 'Where taken' we find the words "Sample of reef"; and under 'Remarks' we find "Free milling." All of which is merely pretentious. As might be expected, the prospectus is adorned with the usual list of bankers, solicitors, auditors, and brokers, but no consulting engineer appears on the list of the headquarters staff. The subject may not seem worthy of such serious consideration but the Kasuto prospectus is a striking illustration of what a prospectus should not be and as such affords an example to be avoided.

Priority of Discovery.

Re-invention is an event of frequent occurrence, especially in metallurgy. An investigator evolves some idea without being acquainted with the results of the labours of previous workers, and on publishing his discovery is often mortified to find that he has been anticipated. In metallurgy there are many reasons why a pioneer invention does not receive the publicity which is desirable. It may be that the inventor has not been able to apply his idea commercially, either from the indifference of those in a position to help him financially or he may not have had the most favourable opportunity of applying it. Then again he may not fully appreciate the value of his discovery. Finally he may recognize its value and keep it to himself. These remarks have been prompted by the receipt of a letter from Salt Lake City, from the General Engineering Company, of which Messrs. J. M. Callow and J. W. Neill are the leading spirits, in which it is pointed out that the 'Calculations of Percentage of Recovery' by Mr. Theodore J. Hoover appearing in our August issue have been anticipated by the company's engineers. They have sent us their 'Ore Testing Bulletin,' and we find, among a vast amount of most interesting data connected with crushing and concentration, mention of the formula in question. This bulletin had never come into the hands of either Mr. Hoover or ourselves and it is possible that if it had the shortness of the reference to the formula might have caused us and him to overlook it. That this company should have used this formula, and others of the same character, in their own work for several years goes to endorse our view of the practical value of them. We may here men-

tion also that an English specialist on concentration, of ingenious mathematical turn of mind, has shown us his own work on the same lines. Thus different minds came to the same mathematical conclusion. But that is not all. We are, of course, advocates for the free dissemination and discussion of ideas, and we therefore give the greatest credit to those who freely give their own experience to be published in the widest and fullest way possible. In this particular case the General Engineering Company can claim prior publication but the chief thanks are due to Mr. Hoover for his elaborate explanations of the application of the formula and for his willingness to publish them in a medium of the widest circulation among his fellow-workers.

Cyanidation.

We understand that the introduction of the vacuum-filter, for the treatment of slime, is proving successful on the Rand. A Butters machine of 500 tons capacity has been started by Mr. F. L. Bosqui at the Crown Mines, with the result that the residue, containing 0·22 dwt. per ton, has been reduced 50%. This plant includes all the improvements designed by Mr. C. G. Patterson and exhibits a high degree of mechanical perfection. The slime is wonderfully pervious to solutions. In this respect the Rand affords conditions far more favourable than those that usually obtain in America or Mexico, for the character of the slime is such that 1½ inches of cake forms on the leaf in 20 minutes. This is a fact eloquent to a cyanider. In consequence of the good showing made at the Crown Mines it has been decided to install a vacuum-filter plant of 1000 tons capacity per day at the Robinson and another at the New Modderfontein, which means that the splendid decantation plants at these mines will be discarded. Incidentally we recognize a pleasant compliment to Mr. Charles Butters, who was connected in a metallurgical way with the Robinson in the days when chlorination was applied to the pyritic concentrate. Another interesting bit of news relates to the experiment with zinc-dust as a precipitant, it having been shown at the Village Deep that solutions diluted to 0·012% cyanide and containing only 0·3 dwt. gold gave a complete precipitation of the gold when zinc-dust was added. These results are in strong contrast to the trials made three years ago on the Rand and presage a further development. The tendency is to coarse crushing, as advocated by Mr. W. A. Caldecott. The Modderfontein B mill is to have stamps weighing 1650 pounds apiece, giving a duty of 20 tons with screens of 3 mesh, or 0·27 inch aperture. Improvements in the tube-mill practice are designed, including a separation of sand from slime before collecting in the leaching vats, as against the hose-filling method now in vogue. Further, the ratio of sand to slime will be reversed, the production of slime being increased to nearly 60%. It remains to add that the kindly reception given to the vacuum filter and other American devices on trial in South Africa bears obvious testimony to the unprejudiced and truly scientific attitude of the metallurgists responsible for the splendid technical achievements that have contributed in so striking a manner to the creation of a great industry in the Transvaal.

We note with interest that the group of big mines at Treadwell, Alaska, is to be provided with a cyanide plant for the extraction of the gold in the pyritic concentrate heretofore shipped in barges to the smelter at Tacoma. This new plant includes a Merrill precipitation press having a capacity of 400 tons of solution per day. At the Santa Gertrudis and La Blanca mines at Pachuca, this method of precipitation has been adopted, after thorough trial in the big Homestake and Goldfield Consolidated mills. Zinc-dust is the precipitating agent, so that this departure, which can scarcely be called new, for it was first tried in Montana in 1897, is in harmony with the latest practice on the Rand.

METAL MARKETS

COPPER.

Average prices of cash standard copper :

September 1910.	August 1910.	September 1909.
£55. 6s. 5d.	£55. 17s. 4d.	£59. 3s. 3d.

Copper has been inactive under the influence of labour disputes on this side of the Atlantic and of politics and crop prospects on the other. The market has therefore been dull, and fluctuations narrow, with an abnormally small turnover. The large increase of 4000 tons in the American production for August over July proved disappointing to operators, who appear to overlook the fact that a decrease in the output from the mines cannot be shown in the returns from the refineries before November. The consideration that deliveries both for home and export more than counterbalanced this increase was subordinate to the fear that the heavy shipments to Europe were largely intended to be put into public store. The groundlessness of this fear is shown by a study of the Board of Trade returns which record a decrease in imports for the previous 8 months of 26,000 tons and an increase of exports for the same period of 13,000 tons. While operators were unusually reserved there has been some further realizing by stale bulls who bought last July and some bear selling later in the month was encouraged by the unfavourable position of the American steel trade. The offerings were insufficient to seriously affect values. Dealers absorbed standard copper to cover sales of refined. The rise in the Bank rate to 4% weakened prices somewhat and the opportunity was taken for a general bear covering. Speculators are impressed by the market's steadiness after months of decline and in the face of so many disturbing factors. While they show little inactivity at the moment there are signs that with the settlement of the uncertainties over the crop situation a substantial buying movement will be developed. Already cheap offerings of electrolytic have disappeared and buying orders of considerable tonnage on American account are reported. In strong contrast to the speculative side the consumers have been purchasing with unflagging activity. With the lifeless trend of prices they have naturally been little disposed to cover forward requirements, but for early delivery large tonnage continues to change hands. Their labour difficulties are at the root of much of their hesitancy, but a settlement of these cannot be long delayed.

TIN.

Average prices of cash tin :

September 1910.	August 1910.	September 1909.
£160. 8s. 7d.	£155. 8s. 2d.	£137. 14s. 6d.

The feverishness of this market, which culminated in a bear raid during the latter part of August was continued well into September and until bears were driven to cover their September prompts. At this point the controlling interests lent warrants with some freedom, and the market became more natural and showed greater vitality, and with it consumers showed more disposition to fill up depleted stocks. Trading, however, soon fell into a listless condition and speculators lost interest, discouraged by the uncertain attitude of the leading dealers. Fresh bear selling met with little opposition, the three months' price relapsing from £158 to £156. Their indifference to the course of prices was no doubt the deliberate policy of the chief bulls to meet the Banka sale at the end of the month at which they bought 1500 tons out of 2200 tons sold. The price realized, about £158. 10s., showed that competition to secure the metal was not keen, and weakness supervened under renewed bear selling and increased by re-shipments of tin from New York to London. With the market so fully controlled this manœuvre is scarcely likely to break prices as its authors hope.

LEAD.

Average prices of soft foreign lead :

September 1910.	August 1910.	September 1909.
£12. 12s. 6d.	£12. 10s. 9d.	£12. 15s. 3d.

The supplies coming forward to the London market have proved insufficient to meet the buyers' demand. A somewhat increased enquiry induced a slight rise in price, which in turn has led to an increased volume of purchases by consumers becoming indifferent, through the market's recent steadiness, about holding reserve stocks. On the continent there has been heavy buying.

SPELTER.

Average prices of ordinary brands :

September 1910.	August 1910.	September 1909.
£23. 2s. 7d.	£22. 14s. 0d.	£22. 17s. 2d.

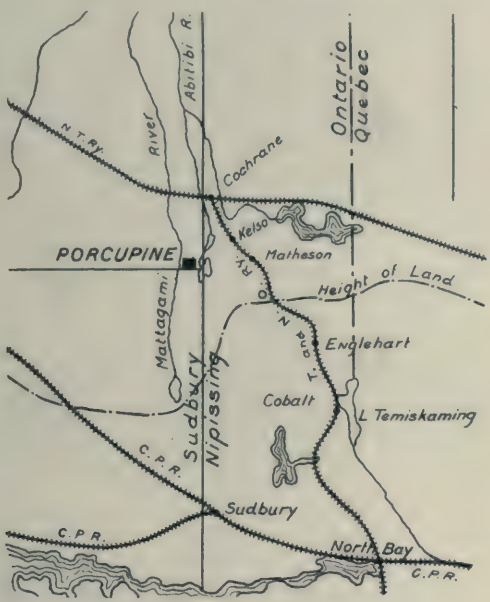
A further slight rise has taken place in the Syndicate price, but after the recent heavy purchases sales have not been on the same large scale. The zinc sheet industry has probably never been so busy, and the rollers have been unable to tender for important orders.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

TORONTO.

Porcupine.—This camp is getting in its supplies by gasolene launches, which run to within six miles of the mines. Development is being actively pushed by the Timmins syndicate, which has sunk three shafts, the deepest on the Hollinger property being down 140 ft. Ore is being treated in a small 2-stamp mill and a highly satisfactory yield is reported. This syndicate owns 70 claims in all and has 10,000 tons of ore blocked out. The Porcupine Gold



Mines Co. has taken out a quantity of high-grade ore and will erect a stamp-mill as soon as possible. Other properties where development is being pushed are the Crown Chartered, Scottish Ontario, Wilson, and Vipond.

Kenora.—There is a marked revival in the gold mining industry of the Kenora and Manitou Lake districts of north-eastern Ontario. The Mikado mine, which has been idle for several years, has resumed operations with a force of 30 men and will have a 20-stamp mill running in about a week. There is rich ore on the 180 ft. level, besides enough of milling grade in reserve to keep the mill going for two years. The Ophir gold prospect, which has also been closed for some time on account of a disputed title, is to resume. A contract has been let for sinking a shaft. Active operations are being started at the Laurentian in the Manitou Lake area, which has been acquired by the Merger Mining Co., a new organization. The Redeemer, in the same vicinity, is being unwatered preparatory to re-opening.

Gowganda.—There is little news from this district, where difficulties of transport still hinder profitable mining. A 30-ton consignment of ore valued at $40,000 was recently shipped from the Gates property owned by M. J.

Porcupine, in Winter.

O'Brien, the Cobalt millionaire, being hauled in wagons from the mine to the Montreal river. The excessive freight rate make it impossible to ship anything but high-grade ore at a profit, so the output is likely to remain low for some time and many enterprises which under other conditions might prove remunerative are at a standstill or doing little. The Otisse at Silver Lake, on which a large amount of development work has been done lately, is closed down and the capital has been increased from $2,000,000 to $2,500,000 to enable the work to be resumed. At the Reeves-Dobie a concentrator is being erected. A wagon-road is in course of construction between Charlton, a station on the Temiskaming & Northern Ontario railway, and Elk Lake, which will shorten the distance and give a good highway for teams at all seasons. This will materially improve conditions. An

electric line will probably follow before very long.

Ore stealing, known locally as 'high-grading,' is now a thing of the past, except it may be on a very small scale, owing to stringent legislation, but bolder methods of robbery appear to have taken its place. On the night of September 5 the bullion vault of the Nova Scotia mine at Cobalt was broken into by a gang and silver bars to the value of $17,500 were stolen. It was evident from the circumstances that the robbery was the work of men familiar with the premises and the police were not long in tracing the crime to several employees of the company, two of whom have confessed. The silver was recovered with little difficulty.

Cobalt.—During the earlier part of the month there was a decided revival of public interest in the Cobalt stock-market, which had been in a condition of depression all the summer. It was almost entirely confined, however, to the cheaper issues, which for a time steadily advanced in price stimulated by extensive buying orders from New York. More recently, however, this has been followed by a recession, but not of a serious character, and the brokers hope for an active campaign in the autumn. The advance movement was based on favourable reports from the camp as to new strikes or increased output. Good finds have been made on the Beaver, Ophir, Badger and other properties of the non-dividend class, and some rich ore is being taken out of the Nova Scotia at the fifth level on a vein that is the subject of litigation between that company and the Paterson Lake. The Temiskaming reports a highly successful month in August with a total production of 251,968 oz. silver, valued at $125,984, at a total cost of $22,014.

Dividends.—The big mines are holding their own well both in the matter of output and dividends. Crown Reserve has declared a quarterly dividend of 6% with 9% bonus; Right of Way has declared its usual 2% quarterly dividend, bringing the total dividends paid to date up to 71% of its capital. The Nipissing and La Rose will officially announce their dividends on the 19th, when it is understood that the regular payments will be arranged, being 5% in the case of the Nipissing and 2% to the La Rose shareholders. It has been anticipated that the La Rose management would endeavour to re-establish the former 16% rate, but they have wisely decided to postpone the payment of higher dividends until they have a larger cash surplus. Recent developments at the Kerr Lake, the high-grade ore reserve of which was said to be depleted, are of a re-assuring character. The yield of silver for August was about 200,000 oz., of which approximately 165,000oz. was from vein No. 7 at 150ft. There remains 450 ft. more of this vein to be opened up and several smaller branch veins are also being followed up. The total ore production of the Cobalt mines for August was larger than during any previous month of the year, amounting to 3099 tons, which brings the total for the first eight months of 1910 to 20,957 tons, a large proportion being in the form of concentrate.

The Green-Meehan, which had been regarded as a hopeless failure, has resumed its place among the active issues; the stock, which was down to as low as 1 cent, changing hands in large quantities at from 4 to 6 cents. The mine has been leased for five years to a syndicate headed by E. E. Kingswell, who is to spend $30,000 in development. The Buffalo is doubling the capacity of its cyanide department, which will save half the present cost of labour and power. The Black Mines Consolidated having exhausted its funds, the shareholders have authorized the pledging of the assets to raise a loan of $25,000 to continue operations.

SPOKANE.

Washington.—Ore shipments from the Republic district amount to 4000 tons per month, which is divided between the smelters at Tacoma, Grand Forks, and Greenwood. This is highly silicious gold ore and is in demand for converter lining. The First Thought mine, at Orient, which produces a gold ore, is sending 50 tons per day to the smelter at Trail, B.C. This property is in charge of Alexander Sharp, and belongs to P. Burns, of Calgary. It is probable that a mill will be erected for crushing and cyaniding. Some development is in progress in the Metalene district, where fresh finds of lead carbonate and galena have been made recently. This district is soon to be tapped by a railroad; the line of the Idaho & Washington, being built from Spokane, is now within 10 miles of Metalene. The Great Northern railroad company's Okanogan branch is being extended from Oroville to Brewster, the latter being at the head of present navigation on the Columbia river.

Montana.—The Radersburg district has been greatly revived within the last year. It has two mines from which gold-bearing pyrite is being shipped to smelters at Butte. One of these, the Keating, is well equipped and is opened by a 400-ft. vertical shaft and a 675-ft. incline. The shafts, 800 ft. apart, are con-

nected on the 400-ft. level. The ore averages $15 per ton. The other mine is Black Friday, from which small shipments worth $40 to $50 per ton are being made. These mines are 12 miles from the railroad at Toston, the wagon-haulage costing $2 per ton; the railroad transportation from Toston to Butte being $1·25 per ton. The Boston & Corbin Copper & Silver Mining Co. has the Bertha group well developed, at Corbin, and the matter of erecting a concentrating mill is being considered. The ore consists of chalcopyrite in quartz. N. L. Amster, interested in the Shannon at Clifton and in the Arizona Commercial at Globe, Arizona, is at the head of this company. The

At Murray, Idaho.

Alta, an old mine at Corbin, is being further developed from a shaft, from which, at 700 ft., the Alta vein has been cut below the old workings. The old Elkhorn mine is being operated with a force of 200 men, the silver-lead ore being shipped to the smelter at East Helena.

Idaho.—New development in the Cœur D'Alene country is mostly on the North Fork, or in the Murray district, and in the vicinity of Kellogg and Wardner. Since the completion of the railroad to Murray the number of men at work on the Monarch, Paragon, Bear Top, Black Horse, and Jack Waite mines have been increased. The Monarch and Bear Top are each operating a concentrating mill, and a mill is being erected at the Black Horse mine. Two other small mills are operating on Pritchard creek. The country is quartzite and slate, the latter containing some veins of gold ore. The mines named above produce lead and silver. The Caledonia and Stewart, situated in the Wardner district, have been shipping ore during the last six or eight months. The former is opened to a depth of 500 ft. on the dip of the vein and has an excellent grade of ore. On the 300-ft. level the lead carbonate is accompanied by chloride of silver and native silver; on the 500-ft. is a body of galena and silver sulphide. An adit is to be driven from Deadwood gulch to tap this vein several hundred feet below the 500-ft. level. This work is in progress. It is probable that a concentrating plant will be erected in 1911 on a site in Deadwood gulch. The Stewart, which belongs to F. A. Heinze, is producing about 200 tons of ore per day, which is being concentrated at one of the Federal mills at Wallace.

MELBOURNE.

Flotation Processes.—The air is full of war and rumours of war. The Minerals Separation Co. is pitted against the Amalgamated Zinc (De Bavay's) Co., Potter's Sulphide is in the field against the Minerals Separation and the Sulphide Corporation, the Minerals Separation is against the Zinc Corporation and the proprietors of the Elmore patents are proceeding against the Minerals Separation. The prize, of course, goes to the one that proves its claim to the master patents. All the lawsuits, except that in which the Zinc Corporation is concerned, are being fought in Sydney, for the simple reason that the companies are operating at Broken Hill. The men who are going to benefit from the litigation will be the lawyers, patent agents, and metallurgical experts. The Potter's Company, of course, has rights relating to the use of a hot acidulated solution established by a High Court decision and the point of interest is that the Amalgamated Zinc Co. holds an option over it for the next twelve months. The great pity is that all the process companies cannot be consolidated and brought under one control, for there are great metallurgical possibilities existing and it is a pity that so many clever people should waste time in litigation.

Broken Hill.—The Proprietary company has just issued its half-yearly balance sheet, which shows that for the 16 weeks of actual operation the profit was £35,000. The mine is closed down and the company is relying absolutely on its custom business and on the profits from its zinc residue to pay the dividend and keep going ahead. There can be no question that the management is wise in keeping

the mine idle. With lead at £12. 10s. per ton the ore would be exhausted merely for the sake of wages. As it is the company is doing some development work, which, when the long expected advance in the price of metals takes place, will prove most useful. The South company, at the other end of the district, shows, even with its large orebodies, how much it is benefiting from the flotation process, for its profit from that source is almost equal to that from the lead-silver concentrate. This company also has not worked full time for the half-year. It is apparent that it will soon be able to show a much improved financial position, for it has not yet received from the Amalgamated Zinc Co. more than the flat price of 3s. 10d. per ton, which has to be paid for its zinc residue before the Amalgamated takes an equal share. Then costs are deducted and any profit remaining has to be divided between the two companies. With the price of zinc so satisfactory the amount of profit accruing to the South company must be considerable. The event of most metallurgical importance in connection with the Barrier is that the Proprietary expects to have its nest of zinc-furnaces finished by the end of this year. The company has been making elaborate experiments with the clay used for the retorts and the report is that the variety now used stands the heat admirably. A great subject of doubt in respect to the spelter industry is whether labourers will take to the work. The company, however, appreciates that to induce constant effort some special inducement must be offered, therefore the zinc-furnace hands will receive a special bonus for efficiency. This has proved to be a great draw and the directors seem confident that the labour difficulty will not prove the bugbear that some of the critics have suggested.

The Mt. Lyell Mining & Railway Co. has decided to refine its blister copper at the Electrolytic Co.'s works at Port Kembla in New South Wales. The Electrolytic is practically an off-shoot of the Mt. Morgan, which sends to it all its 'blister' for refining, and the work has been done so satisfactorily as to create a large demand for the electrolytic copper. The Mt. Morgan blister copper however contains no silver and as the Mt. Lyell product is fairly rich in that metal the refinery was enabled to offer special inducements to the Mt. Lyell directors. The additional product to be handled will entail the expenditure of a large sum for enlarging the Port Kembla works. As loyal Australians we on this side are delighted to see this new enterprise doing so well. Hitherto the Mt. Lyell copper has been sent to Baltimore, in the United States. Should the spelter industry expand at Port Pirie, and Port Kembla be able to grab the Cloncurry blister copper, then two big industries will be established. It would surprise no one to see some steps taken to compel the smelting in Australia of our lead concentrates instead of having them sent to Germany.

Mt. Maroomba is a fiasco. Andrew Wilson now condemns it utterly. He says that huge diorite dikes exist, in the hollows near-by "layers" of zinc and lead ores are found, but shallow shafts suffice to reach barren country. The public has taken this decision soberly; they went in for a gamble and took their loss like men of spirit. The Balfour field also is depressed though there development work is being pushed ahead with a good deal more vigour than in several other new districts to which attention has been directed.

Chillagoe.—Alec Macgeorge has returned to Melbourne. He has been in the Etheridge district, looking after the properties that the Chillagoe Co. has bought or over which it has options. Recently two of the directors have visited the locality and from what can be heard they believe so thoroughly in the outlook that it is understood that J. S. Reid, the chairman of the Chillagoe, who is now in London, will raise capital for a new company to handle the Etheridge leases. The Etheridge railway of the Chillagoe Co. really brings under the control of that company an area of 11,000 square miles full of minerals; so the hope is that the Chillagoe will yet fulfil its function as a great industrial enterprise, as originally designed by the promotors. This, too, in spite of the dreadful over-estimate of ore on which the company raised its original capital.

Kalgoorlie. — The news respecting the Golden Horseshoe and the Associated mines received from London has not come altogether as a surprise. A strong impression has existed here that the Kalgoorlie shares were better selling than buying and some of the knowing ones have been acting accordingly. Certainly they have profited by the fall in the price of the Great Boulder, on the poorer prospect at the bottom level.

Personal.—W. J. Loring, of Bewick, Moreing & Co., has gone to New Zealand to inspect some of the mines there in which his firm is interested. It is now an open secret that D. P. Mitchell has decided not to stay at the Great Fitzroy mine in Queensland. That may mean that he leaves the service of Bewick, Moreing & Co.

Charters Towers.—The position of affairs in this district is more reassuring. The output of gold is bigger and development work is being carried on most vigorously. Some of the outside mines, such as those on the Cumberland line, are expected to make an improved showing. Both the East Mexican and the New Brilliant Freehold are in richer ground. On the Brilliant Block sinking is going ahead to pick up the Day Dawn reef. Should the prospecting operations in the central part of the district result in any discovery of importance the position will be vastly improved. Speaking of Queensland mining the State Treasurer (Mr. Hawthorn) deplores its depressed condition. But he hits the nail home when he points out that apart from the low price of metals the fact that people are making fortunes in pastoral and agricultural pursuits is helping to keep capital away from mining. The coal measures of the State alone appear to be able to offer enough inducement to investors. Farther south the troubles with the pit men make most owners wish they had never seen a coal mine, but with more coalfields the power of the Union in Newcastle will be weakened.

NEW YORK.

Political Conditions.—Probably the most significant event of the month, and the one with the farthest reaching consequences, was Mr. Roosevelt's trip through the West, and the great series of ovations he received. It is evident that he has lost none of his skill in interpreting public opinion nor has his hold on the people been in any degree diminished. It will probably be difficult for citizens of other countries to realize at once his wide-spread popularity, and the fact that it does not in any way portend disaster to our institutions, however much it may disturb particular interests. Mr. Roosevelt correctly explained the secret of his power in one of his speeches in which he recalled the years he spent as a ranchman in Dakota. He understands what the average man is thinking, because he has been one of them and is so fortunate as to keep fresh his point of view. Wall Street was much disturbed by the renewed proof of his popularity and by his speeches, in which he made entirely clear the fact that he had not changed his attitude toward many of the things that Wall Street holds most dear. Prices tumbled and speculative stocks became a drug. Not all of this, it is true, should be imputed to Mr. Roosevelt. In this as in other things he, as a phenomenon, is significant as a sign of the times; just as he is powerful because he says what the average man thinks. The event is important not because Mr. Roosevelt says certain things and proposes to accomplish certain reforms, but because it reveals the purpose of the people to change our methods of transacting business. The nature of those changes was made clear in the course of Mr. Roosevelt's numerous speeches, especially those delivered at Osawatomie, Kansas, and St. Paul. He took a stand squarely with the Insurgent or Progressive wing of the Republican party, which has for its ideal the elimination of 'special interests' as a factor in politics and government. It has long been understood, though not preached from the house-top, that actual government in America is largely in the hands of men selected directly or indirectly by the leading financiers of the country. The New Nationalism of Mr. Roosevelt proposes a return to simpler democracy and the enhancement of the political importance of the average man. The means to be adopted include open primary elections for selection of candidates, the initiative and referendum, and a more direct appeal to the people by political leaders. Whether in the long run the ideals and the judgment of the masses will prove better than those of the present controlling group is open to question.

It is still more doubtful whether any considerable portion of the people can be brought to the same state of vigilance and continued activity as the professional politician and his business backer. However, the autumn elections up to date indicate that temporarily, at least, the people are spurred to activity and enamoured with the plans proposed. To mining men, the principal points of interest in the programme of the Progressives are: (1) close contral over inter-state corporations and (2) a change in the methods of disposing of public lands. It is the first proposal that has disturbed the stock market, for any general control of the situation by the Government must decrease the chances for speculative profit. Before lamenting this too greatly a historical parallel is worth remembering. When the national banking system was introduced, speculation in wild-cat currency was stopped, but business as a whole was greatly benefited. The second proposal touches miners more directly. It has long been foreseen that some change in the public-land policy was inevitable. The existing laws have been almost absurdly liberal and have been so illogical and ill adapted to modern conditions as to invite fraud. The trouble is that there is no consensus of opinion as to what changes should be made and naturally there are many that prefer to take chances with known conditions than venture into something new. In the opinion of Mr. Roosevelt and of Mr. Taft, water-power sites, and coal, oil, and phosphate lands, at least, should not be sold, but instead should be leased on terms designed to secure at once wise development and proper conservation. It is evident that the exact terms of such leases will be difficult to formulate.

Conservation Congress.—The disposition of the public lands formed one of the topics most actively discussed at the second session of the Conservation Congress at St. Paul, Minnesota, early in September. It was there that Mr. Taft and Mr. Roosevelt defined their views. The most significant event of the gathering was the strong stand taken against the attempted revival of the old doctrines of State rights, in the form of a proposal to turn over to each State the public lands within its borders. This plan had the backing of a number of the Governors and other influential men in the West, but found no favour at the hands of the Congress as a whole. Delegates felt there was entirely too much truth in the implication of Mr. Roosevelt, that the proposal was really a covert one in the interest of the larger public service corporations, which expected to be able to make better terms with individual States than with the National Government. While there is much discussion of these problems actual progress is slow, though last year Congress provided for separate title to surface and mineral in the case of coal land and also defined the heretofore doubtful authority of the President to withdraw lands from entry. Under this authority Mr. Taft has withdrawn great areas of coal, oil, and phosphate lands, and Officers of the Department of the Interior are investigating conditions, especially in the California oilfields, with a view to securing remedial legislation this winter.

The Bureau of Mines is at last organized and at work under a duly appointed Director. Thus a movement that has had earnest support from many mining men has come to fruition. The act providing for the Bureau passed Congress early in the spring and the Bureau itself was established July 1, though under the temporary direction of George Otis Smith, the Director of the Geological Survey. There was considerable friction over the appointment of a permanent head but eventually the President selected J. A. Holmes, the leading candidate and a man well qualified for the place. Mr. Holmes is a man of experience and culture, and is widely and well liked. The new Bureau is charged with the duty of investigating conditions relative to safety and economy in mining throughout the United States and is expected to become an important agency for betterment of conditions. It starts under excellent auspices and with good equipment, that belonging to the old Technologic Division of the Geological Survey having been transferred to it.

The strike of the bituminous coal miners is nearly at an end. Since April 1 a large number of men have been idle, but settlements had been negotiated in one district after another until only in Illinois and the Southwestern district, including Oklahoma, Arkansas, Kansas, and Missouri, were many mines closed. As the winter approached and real pressure for fuel began to be felt it became evident that a settlement of some sort would have to be reached. In Illinois, the operators and miners failing to agree, the International president of the Miners' Union negotiated a compromise that seemed likely to be adopted. The local officers of the Union felt, however, that their prerogatives had been usurped and also were confident that the operators could be forced to give still better terms. Under their influence the men rejected the compromise and later this action of the Illinois miners was sustained

in a stormy special session of the Union at large. It seems that the local officers were right in their surmise as to the weak position of the operators, since negotiations have now been practically completed on a basis more favourable to the men than was the proposed compromise. This practically closes the matter, for the Illinois operators formed the only large fighting group on the side of the companies. The men have won all along the line except in Colorado, where their hold is small and defeat is staring them in the face. The coal industry in America is so fiercely competitive that adjustment of wages in individual districts is not easy.. In the Middle West, recently published Government figures show the average annual return per worker to be about $420. It is at once conceded that this is too small a sum to permit an American workman to live and rear a family that shall be a credit to the State, but the fault is more in the conditions than with the operators. Owing to the fact that demand is only heavy for a few months and that no means have been found for storing the coal without loss by fire, the average number of days worked in the mines in Illinois last year was 189. Until some method is found to permit these collieries to be worked steadily, or to prevent competition by more fortunate plants, it is difficult to see how conditions can be much improved.

A TRAIN-LOAD OF COPPER. One of the reasons why the price of the metal is low.

SAN FRANCISCO.

Copper is attracting less attention as the disturbing surplus disappears. Increased consumption and curtailment of production has eased the situation. In the meantime Utah Copper has acquired a block of Nevada Consolidated stock that gives it a clear majority in the holdings of that company. Nevada Consolidated continues to make good records both as to production and costs. The company has recently made the largest single shipment of copper ever made from Nevada. This started on its journey to the refinery at Baltimore September 14 and consisted of a train of 22 cars, carrying 50 tons each, a total of 2,200,000 lb. of blister copper. The cost of production has been stated to be about 6c. per lb., so that the profit on the 22 cars would be about $143,000 from copper alone, to which may be added the gold at 20c. per ton for all ore treated, raising the total net profit to about $155,000 for nine days' output of the plant. The output of copper is not of itself remarkable, but it is the first time in the history of the plant that so large a shipment was made in one consignment, and therefore has attracted a considerable amount of interest and enthusiasm throughout the district.

Petroleum.—The price of oil and the laws governing the disposition of Government lands are the two subjects that are receiving practically all of the attention of California oil operators. An interesting situation exists in the matter of the price and no one seems to know whether the next change will be for better or for worse. The Standard and Associated companies have cut the price, but they both need oil; the Union and Independent agencies have a large surplus and are trying to maintain the price. Regarding the matter of laws relating to oil lands, two organizations have been formed to secure legislation. The Bakersfield organization, called the 'California Oil Men,' is opposed to conservation but believes in a revision of the laws formerly existing. It is working harmoniously with the Western Oil Producers' Association, recently organized in Los Angeles. Both organizations have many members in common. The Western Oil Producers' Association held a stormy meeting at Los Angeles on September 8. The balloting for directors, which has been carried on by letter, disclosed the fact that those elected were almost all anti-conservationists. The secretary, S. C. Graham, who had been active in organizing

the Association, withdrew declaring that he could not work with a body controlled by men with views differing so radically from those held by him. This caused much animated discussion, as did also a motion instructing the directors to work for amalgamation with any other organization having the same object in view. The motion was passed. Only about 30 members were present at the meeting. A meeting of directors will be called and the officers of the Association elected. Gifford Pinchot has been visiting the oilfields preparatory to defending the Conservationists at the American Mining Congress.

Gushers.—The American Oilfields Co. has another gusher in the Midway district. This well, No. 56, brought in about August 10, early in September began spouting at the rate of 15,000 bbl. per day. Well No. 68 is flowing 6000 bbl. per day, and No. 79, the company's largest gusher, has increased to more than 25,000 bbl. per day. Well No. 1 of the Consolidated Midway, controlled by two 10-in. gate-valves, is being held down to about one half its full capacity. This well, which began flowing on July 1, is 2167 ft. deep and is capable of producing 60,000 bbl. per day with open valves. Three other wells, all in gusher territory, are due to 'come in' within the next 30 days. This company is drilling five new wells in the Kern River field. The Lakeview gusher of the Union Oil Co. is now yielding about 17,000 bbl. per day. No. 14 and 17 have recently come in as water wells with a flow of 20,000 bbl. per day each. Work on the large reservoir is keeping well ahead of production. The company's output in the Midway field is around 30,000 bbl. per day. A committee from the Independent Agency recommended that in September all new contract oil be refused so as to permit running of the Lake View surplus. It was feared that with the coming of the rainy season the dams holding back the lakes of oil stored at the surface would be broken and that the floods of mingled oil and water would do large damage as well as entail great loss. No orders to this effect were, however, given and only the usual amount of Lake View oil is being taken by the pipe-lines.

Production.—Figures of California oil production for the month of August show a heavy decline in the San Joaquin Valley fields, where the bulk of the fuel oil is produced, and an increase of refining oil in the Fullerton and Ventura fields. The net decline in the valley fields is 243,899 bbl., and the decline in all fields is 1,580,806 bbl. under July. In the valley districts Coalinga fell off 325,812 bbl., Maricopa 269,100, and Kern River 16,908, while Midway, with the American Oilfields gusher in operation, gained 359,000, and McKittrick 8921 bbl.; the total production being 5,057,117 for August, as against 5,301,016 for July. The southern districts produced 928,600 bbl. in August, as compared with 879,944 in July, and the coast districts, 757,442 bbl., as against 721,005. The total production was 6,743,159 in August, compared with 6,901,965 in July, making a daily average of 217,521 in August, against 222,644 in July.

Other American Oilfields.—Outside California the principal interest in petroleum now centres in the Southern and Middle Western fields. Both production and price continue to fall in Pennsylvania. In Illinois the production now stands at about 90,000 bbl. per day with 23,000,000 bbl. in storage. The Ohio Oil Co., local representative of the Standard, has erected a plant at Martinsville where the lighter oils, naptha and gasoline, are refined for the local market, after which the residue is returned to the pipe-lines and sent East for further treatment. In the Mid-Continental field of Kansas and Oklahoma, adequate transportation is now available and oil is being run freely. In addition to the old pipe-line to Chicago and then east the Prairie Oil & Gas Co., the local branch of the Standard, has now a line to Baton Rouge, Louisiana, while both the Texas and Gulf companies take oil to Port Arthur on the Gulf. The Caddo field in Louisiana is proving not only a big producer but is yielding high-grade oil. Its output of 40°B. crude has seriously affected Eastern prices.

The Mexican Petroleum Co. of California, operating about 35 miles west of Tampico, chiefly in the State of San Luis Potosi, Mexico, has 20 wells producing and 7 wells drilling. Total production averages 6000 bbl. per day. Fifty Americans and from 200 to 500 Mexicans are employed, the monthly payroll averaging $30,000. This company has a 10-year contract to supply oil to the Mexican Central railroad at 50c. per bbl.: practically the entire output goes to the railroad. The Huasteca Petroleum Co., operating south of Tampico, has three wells drilled and producing; two wells are drilling in the producing field. The wells average 2000 ft. in depth and are producing 10,000 bbl. per day; the oil is entirely free from water and registers 20°B. The pipeline from Casiano to Tampico, a distance of 65 miles, has just been completed; its full capacity is 26,400 bbl. per day. This company employs 15 Americans and 100 Mexicans, and is spending $30,000 per month.

The Lightner mine at Angels Camp, California, has been sold to N. B. Harris of Montclair, New Jersey. This ends one of the many little contests that characterize mining on the Mother Lode. The Lightner claim is one of the oldest in Calaveras county, having been located under the mining law of 1866. The claim is narrow and only 400 ft. long. It lies between the Utica and the Angels and, more by accident than design, covers the heart of the great ore-shoot that extends into these well known properties. The mine was opened by

The Lightner Mine, California.

a shaft in the vein to something over 400 ft. and through winzes the workings extend to 600. As the shaft was sunk in ore it was necessary to leave a pillar, which excited envy in the breast of many successive visitors. Owing to limited surface rights and adverse ownership of ground on the hanging-wall side of the vein, it has never been possible to sink a new shaft and for one reason or another consolidation with the deeper neighbouring mines has never been effected. The ground is heavy and caving has extended to the surface. The whole difficulty has been to get room for a new working shaft. By re-surveys it has recently been found that the property of the company extends farther on the hanging-wall side than was supposed, a public road has been vacated, and room thus made for a new shaft. While a shaft in the foot-wall would have been preferred, it was excluded by the conditions. The new shaft will cut the vein at a depth of 800 ft. The mine was examined by F. L. Lowell under direction of Francis Drake and the firm of J. R. Farrell, R. C. Shaw, and A. M. Younge will act as consulting engineers. The purchase price was $200,000 in addition to which $50,000 is to be spent on the new shaft and development.

JOHANNESBURG.

Discussions.—It has often been said of the various Rand technical men, that the mining engineers, notably the underground men, are the most uncommunicative as to their business and that only the metallurgists and mechanical engineers are disposed to take advantage of Society meetings for the interchange of ideas. The August meeting of the Chemical, Metallurgical & Mining Society was devoted exclusively to mining matters and the attendance of members was a record. Still the allegation as to the reticence of the miners broadly holds good. The standard of the proceedings was not up to that established and a great deal of time was wasted over mere chatter, more suggestive of the ramblings of a loquacious foreman waiting for a skip than the transactions of a scientific society. Not many mining men participated. One paper was read on the 'Efficiency of Labour Underground' by a mining man of great experience, whose notebooks must be full of valuable data. Yet the paper was merely a speech and contained only empty generalizations, like a party programme. Trimmed of its verbiage, the paper virtually expressed the following illuminating ideas:

(*1*) Some men work better than others and should be paid at a higher rate. (It may be noted, incidentally, that there is no mining district in the world that differentiates more substantially between the worth of the good worker and the poor.)

(*2*) First-year students of mining colleges should not be made underground managers until they know the difference between a fuse and a cable.

(*3*) Expert miners are useful men in a mine. Indeed, the patience of the Society was tried for over half an hour while it was explained to members that some men are paid too much and some too little, that the contract and bonus

systems are conducive to the exertion of greater effort than day's pay, that some shift-bosses on the Rand are too young and inexperienced, and that the results of stoping contracts do not always represent the true relative merits of the contractors. All very interesting and true and topical, but scarcely up to the requirements of a Society rightly boasting of the practical and informative character of its work. It is fortunate for its reputation in this respect that S. Penlerick came to the rescue with some highly practical notes on the ventilation system introduced at the East Rand Proprietary, of which he is joint manager.

Ventilation and Phthisis.—This subject has been keenly discussed during the past few weeks. Good work in the direction of mechanically providing pure air underground has been done in three mines, for a year or more. The report of the Mining Regulations Commission, which recognizes the unquestionable truth that by good ventilation only can miner's phthisis be checked, has now started the talk again and will doubtless stimulate further practical work. Mr. Penlerick's facts were interesting in the extreme and will provide useful guidance. He declares that the scheme as applied to the East Rand is not in detail applicable to every mine, but the general principles will apply. The "general principles" are simply those of mine ventilation. As for differences of detail, this largely expresses the big breach between the simple one-reef mines of the East Rand and the complicated tangle of workings extending from Germiston to Langlaagte, where several reefs are usually worked and where upper old workings are ever providing their valuable quota to the mill-bins.

At the East Rand Proprietary, Mr. Penlerick tells us, two old prospecting shafts have been converted into up-casts by means of the two fans, as follows:

Fan	Diameter	Width	Output	Water Gauge
			Cu. ft.	
Sirocco Double Inlet	10ft. 6in.	8 ft. 6½ in.	300,000	3 in.
Barclay's Double Inlet Drum Pattern	16 ft.	8 ft.	350,000	4 in.

"In the upper levels, where no work is proceeding," the levels are securely bratticed. As suggested, this is a condition rarely obtaining on the central Rand, where the regulation of air would be more complicated. From the 6th to the 17th levels inclusive, self-closing doors are fitted in the brattice and the admission of the air is regulated as required. Local or auxiliary ventilation is aided by means of a 21 in. Sirocco fan at the 19th level, exhausting the air from below. In the development drifts, a galvanized iron pipe is used as the outlet, in order to keep the traffic-way fresh throughout. As for the results of the ventilation as a whole, Mr. Penlerick gives the following analyses of air, before the adoption of the scheme: CO_2, 0·493%, and CO, 0·012%: after its adoption: CO_2, 0·127%, and CO, 0·005%. The capital expenditure involved has totalled only £25,000, including fans, motors, and all mine bratticing and equipment. In concluding, Mr. Penlerick stated: "The cost is insignificant compared with the valuable results obtained and under the circumstances some system of artificial ventilation should be adopted in practically every mine on the Rand." This verdict is declared by Dr. L. G. Irvine, a high authority on hygienic conditions in mines, to be the Magna Charta of the Rand miner.

The principal reason that ventilation, and not patent sprays and other dust-allayers, provides the only real hope of reducing phthisis within limits lies in the fact, now more generally admitted, that the dust and gases due to detonation are more responsible for the trouble than the dust created in actual drilling and breaking. While the enthusiasm for the improvement of underground conditions is commendable, it is necessary to exercise moderation. As an instance of possible extremes may be mentioned the proposal to prohibit miners suffering from phthisis from working underground. As Dr. Irvine has wisely said, such a regulation would lead to medical tyranny of a most undesirable character and would unquestionably induce a dangerous concealment of sicknesses.

New State Mine.—The midnight oil has been burning freely of late in Winchester House, where the Government Mines Department officials are busily attempting to convert more State mining interests into productive assets. The Government's efforts at syndicate-making were eminently successful (from the financial standpoint) in the case of the Modderfontein leases, and the public, which received its 'cash bonuses' from the experiment, has been not disinterestedly awaiting the announcement of another scheme. It now appears that the next area to be offered for leasing comprises 1811 unallotted claims on

the farm Brakpan, together with 424 claims on Schapenrust, belonging to the East Rand Central Company. The necessity for taking in this company's ground on a basis almost proportional to claim area (for the company will receive 18% of the profit accruing to the owners) is not clear. From a broad industrial point of view, however, the inclusion of Schapenrust is satisfactory, as it brings into activity an area that would remain idle indefinitely if standing alone. The ground covered by the new scheme is considerably deeper than the Modderfontein State mines and nearly all of it probably exceeds 4000 feet in depth. The prospects as a profitable mine are also less promising. In a circular issued to shareholders, the directors of the East Rand Central discuss the scheme and its promise in moderate terms — moderate as circulars of this description go. Their suggestion of a 24s. yield is sound, but inclusive working costs at 15s. cannot be safely counted upon. Further, in stating that "the reduction plant must be capable of treating not less than 1,000,000 tons per annum" they fall victims to the lure of round numbers. There may eventually be a mill of this capacity on the mine, ten years hence at the earliest; this figure is not one however to be used in practical calculations of the value of a mining area to the south of Apex and Brakpan, whatever its justification as simple arithmetic.

Conveyor-belt vat-filling system at the Wolhuter Mine.

Vacuum-Filtration. — During the last year or two the Eckstein group has shown remarkable enterprise in the direction of metallurgical research and progress. A notable point in their investigations was reached in August, when the first vacuum slime-filter (Butters) to be operated in South Africa on a working scale was put in commission at the Crown Reef mill of the Crown Mines, Ltd. There has long been, and may still prevail in several quarters, a deep rooted feeling of scepticism against the application of vacuum-filtration to Rand slime-treatment and it is worthy of note that the firm which spent considerable sums in successfully evolving a new vacuum rotary table for the dewatering of sand (erected at the Simmer Deep) has made no move toward the practical adoption of the process. It may be fairly said, indeed, that the subject is a delicate one, in discussing which it is well, especially at the present moment, to leave opinions severely alone. The facts briefly are the following: F. L. Bosqui, advising Eckstein & Co., is apparently convinced that the introduction of vacuum-filtration is not an experiment, but will assuredly oust the decantation process, in spite of the low cost attained in that line of work. The Crown Reef plant has been running for several weeks. It is of a nominal 500-ton capacity, but can handle much more successfully. It has been treating from 250 to 300 tons per 12-hour shift, with only one of two units in operation. Butters filters are to be installed at the New Modderfontein and Robinson works as soon as possible, and the Modderfontein B mill, when erected, will include this type of plant. In journalese, "these facts speak for themselves and comment is needless." Thanks to the freedom with which information is given by one group to another, however costly has been the acquisition, it is to be hoped and expected that the results of working at the Crown Reef will be made public in a few months by those concerned in the

work, which one party of metallurgists may be inclined to call a daring experiment and another a demonstration and application of proven principles.

Simmer & Jack.—The favourable reference in the Simmer & Jack report to "low working cost" and to the "extended mining of low-grade ore not formerly included in the payable reserves, from which it is found a profit can now be obtained," form a timely antidote to the epidemic of 'fathomitis' lately prevalent in other offices of the Goldfields group. There is another point of topical interest in the report. The fully developed ore reserves are estimated at "2,690,000 payable milling tons" of an average assay-value of 6·3 dwt. "In addition" it is reported "from areas partially developed, but not yet fully exposed for stoping, there were indicated some 440,000 payable milling tons" of 5·5 dwt. per ton. Considering the high competence of the group's engineering staff, it may be fairly concluded that the valuation of this 440,000 tons is near the mark, if, indeed, it is liable to an error of realization any greater than that likely to affect the better proven blocks. Why then this delicate distinction between "developed" and "indicated" ore? "Indications" form the basis of estimation for the safest block—even for a 10-fathom pillar. Of what concern to shareholders is this feature of "readiness for stoping." The company treats less than 800,000 tons per year and 2,690,000 'payable' tons are developed. The deficiency of a few winzes and rises in the 440,000 tons, capable of valuation, is comparatively of no concern whatever and the differentiation is a pretentious though fashionable refinement.

City Deep mill.—The new plant is practically completed and will be running shortly. The chairman, R. W. Schumacher, and directors invited the local technical society to inspect the works on September 10 and one is tempted to compare the plant with that of the Simmer Deep visited by the same society a year ago. That there are many novel features in common merely reflects the fact that many improvements effected in the Simmer Deep design were good. Wood again is sparingly used in the battery-house structure and reinforced concrete is more extensively employed in the mill and cyanide plant. The stamps are also run in units of ten, driven by independent 50 hp. motors. Heavy weight is still the characteristic of the stamps, which are of the new long-headed type. Between the mortar-boxes and concrete foundations is a layer of felt, which is considered to take up vibrations more satisfactorily than rubber. In place of king-posts the concrete foundations are carried to the level of the mortar-box tops, on which is set a steel frame carrying the camshafts. This is probably the most distinctive feature of the whole construction. There are two Challenge feeders to each box and no battery amalgamation plates. The 200 stamps are served by 9 tube-mills. All the gold, from amalgamation and cyanide, is recovered under one roof, which covers 7 shaking tables, 12 ft. long (serving the tube-mills), and 18 extractor-boxes. Sumps and vats are principally made of reinforced concrete.

MEXICO.

Pacific Smelting & Mining.—Courtenay De Kalb, formerly editor of the *Mining and Scientific Press*, has taken charge of the affairs of this concern as general manager, and he is systematically preparing to inaugurate a custom smelting business that will be of great importance to the mining industry of the West Coast of Mexico. The Pacific Smelting & Mining owns, through the Compañia Metalurgica y Refinadora del Pacifico, the 350-ton smelter at Fundicion, a station on the Southern Pacific Railroad of Mexico, and through other subsidiary organizations it holds a number of Sonora mines and prospects, besides much ranch and timber land. It has had internal troubles, but its affairs have been readjusted, and it is announced that ample capital is available. The smelter was blown in during May 1908, to conform to the provisions of the State concession under which it was built, but the period of operation extended over only 15 days. Since that time no ore has been smelted there. The former management planned to make the company's El Cobre mine, 25 miles from Fundicion, the principal source of ore supply, but as the El Cobre ores are highly silicious, this would mean the penalizing of silicious custom ores, and as such ores are at present plentiful in the tributary territory, the plan has been abandoned by the present management. It is held, too, that the silicious ores of El Cobre will be of much greater value to the Fundicion plant when basic ores become the rule rather than the exception in the districts tributary. In the Yaqui river region of Sonora, within the territory formerly covered by the Ryall concession, the company has a number of promising properties, and these will be developed. George M. Ryall, who secured the big exploration concession, is vice-president of the Pacific Smelting & Mining. The Fundicion plant is well situated for

custom work, being about midway between Corral and Navajoa, respectively the Yaqui river and Alamos branch junctions. It is 141 kilometres below Guaymas, the principal port of Sonora, and 173 kilometres north of San Blas, the junction of the Southern Pacific and Kansas City, Mexico & Orient roads. Culiacan, the capital of Sinaloa, is 392 kilometres south. The smelter concession exempts the company operating it from all State taxes for a period of 12 years from June 1908, and it is estimated this will mean a saving of 4% on the gross value of the smelter output. The smelter will not be blown in until continuous operation is assured.

Pachuca.—The Mexican Light & Power Co., the strong Canadian concern that controls the power and lighting business in Mexico City, has completed a transmission line to deliver power to the Pachuca district from its Necaxa hydro-electric plant. Delivery has been started. The line has a carrying capacity of 30,000 hp., hence the event is taken to mean that all Pachuca power difficulties are over. Heretofore there have been frequent interruptions in mining and milling as the result of a shortage of power, and of late important moves have been delayed pending an additional supply. The Compañia Electrica e Irrigadora, of Pachuca, which formerly supplied the greater part of the power used by the mining concerns of the district, was absorbed by the Canadian company several months ago. The demand for power has grown rapidly with the greatly increased activity in the Pachuca district. Present contracts for mill construction and mine equipment in that district represent a total of fully 4,000,000 pesos.

Huasteca Petroleum.—This company, which is subsidiary to the Mexican Petroleum Co., of Los Angeles, has completed 108 miles of 8-in. pipe-line from its Juan Casiano field, in the Huasteca district of Vera Cruz, to the Gulf port of Tampico. Oil is being delivered to three 55,000-bbl. steel storage tanks on the bank of the Panuco river. The Huasteca Co. recently brought in a gusher at Juan Casiano, which, at the time of the last report, was flowing at the rate of 14,000 bbl. in 24 hours. The company has put down five wells in that field. There are six pumping stations along the pipeline, and each cost fully $100,000. Each of the six pumps weighs 110 tons. Edward L. Doheny and associates, who control the Mexican Petroleum Co. and subsidiary concerns, plan to build a pipe-line from the Juan Casiano field up to the high central tableland, to a point from which oil can be easily transported by train to Mexico City. However, the projected line depends on the proving of the new field. The Mexican Petroleum Co., which is operating around Ebano, in San Luis Potosi, is supplying 6000 bbl. of fuel oil daily to the National Railways of Mexico.

Oro Grande.—French engineers have arranged to examine the properties of the Oro Grande Mines Co., at La Luz, near Guanajuato. It is stated that in case the engineers report favourably, much French capital will be invested in the Oro Grande enterprise. The Oro Grande was organized to take over the Refugio, Bolañitos, Melladito, and other famous old producers of La Luz, and adjacent mineral ground, representing in cost about 1,000,000 pesos. It has a capital of $9,750,000, divided into $7,000,000 common and $2,750,000 preferred. A few months ago the Oro Grande took over the properties of the Guanajuato Amalgamated Mining & Milling Co., in the same camp, transferring stock and assuming indebtedness of over 200,000 pesos. This gave the Oro Grande a 100-stamp mill, concentraing and cyaniding plant, and ore from old La Luz dumps. Some ore from the Guanajuato Amalgamated mines is being treated, the daily average reaching 300 tons. Profits of from 15,000 to 20,000 pesos per month are being earned, and are applied on the Amalgamated indebtedness. The erection of a new plant of from 500 to 1000 tons capacity is proposed.

Cinco Minas.—The transfer of these properties, in the Hostotipaquillo district of the state of Jalisco, to the Cinco Minas Co., recently organized, has been made. The mines were purchased a year ago by H. E. Crawford, representing the Marcus Daly estate, for approximately 500,000 pesos, and until the recent transfer the titles were in his name. The company is a close corporation, all the stock being held by Mrs. Marcus Daly and her son, by Judge J. W. Gerard, of New York, and Mr. Crawford. The capital is $500,000. The Cinco Minas were rich producers under Mexican ownership, and since their purchase by the Daly interests development has been attended by extremely gratifying results. It is estimated that the proved ore, which includes that left by former owners, totals 500,000 tons, with an average value of 25 pesos per ton. Shipments of high-grade ore from development work average 70 tons monthly, the ore ranging from 5 to 10 kilo. silver and from 50 to 90 gm. gold. It is expected to order equipment for a 250-ton cyanide plant before the end of the year. Crushing will be done by stamps, with re-grinding in tube-mills.

PERSONAL

W. J. BARNETT has been elected a director of the Great Cobar Ltd.

H. R. BOSTWICK has taken charge of the Candelaria mines, in Durango, Mexico.

WALTER BROADBRIDGE returned to the Gold Coast by the steamer sailing on September 21.

A. O. BROWN, who is with Alex. Hill & Stewart, has returned from Rhodesia.

R. E. COMMANS sailed by the *Saxon* for South Africa on September 17.

PAUL S. COULDREY has been appointed general superintendent for the Cerro de Pasco Mining Co., in Peru.

WALTER DOUGLAS has been appointed general mine manager for Phelps, Dodge & Co.

W. R. DOWLING left London for Johannesburg on September 24.

W. F. FERRIER has moved from California to Toronto, Canada.

P. FITZGERALD has been appointed manager for the Oroya Links Co. and left for Kalgoorlie on September 29.

WILLIAM FRECHEVILLE is in Canada.

A. D. GASSAWAY has resigned as engineer to the Lena Goldfields, and has returned to California.

R. H. GOODWIN, manager of mines in Asia Minor, is taking a holiday in England.

HARRY D. GRIFFITHS, manager of the Tronoh mines, has been appointed an unofficial member of the Federal Council of the Malay States.

J. NORTON GRIFFITHS, M.P., has returned to England after visiting Chile and Canada.

J. M. HENDERSON is conducting a geological expedition to Portuguese West Africa for Wernher, Beit & Co.

W. A. HEYWOOD is in Galicia, Spain.

J. POWER HUTCHINS is expected in London from Kassakora, in Siberia.

CARADOC JAMES has been appointed metallurgist to the Taquah Exploration Co., West Africa.

JOHN S. MACARTHUR has returned to Glasgow from Porcupine, Ontario.

T. BRUCE MARRIOTT, recently with Norton Griffiths, Bruce Marriott & Co., on the dissolution of that firm, has opened an office at 62 London Wall under the name of Bruce Marriott and Co.

E. P. MATHEWSON is expected in London at the end of October.

WILLIAM W. MEIN is at Paris.

J. W. D. MOODIE is at New York.

A. MONTGOMERY, State Mining Engineer in Western Australia, is visiting England.

HORACE G. NICHOLS has returned from Siberia.

PEARSE, KINGSTON & BROWNE have withdrawn as consulting engineers for the Alaska Consolidated Mines.

W. PELLEW-HARVEY sails from Marseilles for India on October 21.

ARTHUR J. RICKARD has been appointed superintendent of the Barramia mine in Egypt.

HALLET R. ROBBINS, of Seattle, has been examining mines near Haines, Alaska.

A. P. ROGERS has returned to New York from Siberia.

C. M. ROLKER is examining the Lluvio de Oro mine, in Sinaloa, Mexico.

H. R. SLEEMAN, manager of the Whim Well copper mine in Australia, is in London.

J. H. STEPHENS sailed for Tarkwa, West Africa, on September 28.

LESTER W. STRAUSS has returned to Lima from Coquimbo.

ARTHUR C. TAYLOR sails for the Kolar district on October 27.

J. W. TEALE has returned from Western Australia.

S. C. THOMSON, engineer to S. Neumann & Co., is at Bulawayo.

H. A. TITCOMB is at Boston.

S. J. TRUSCOTT left London on October 5 for Padang, in Sumatra.

H. H. WEBB is at New York.

STUART S. WEBB-BOWEN is returning from the Gold Coast at the end of October

GEORGE E. WEBBER, the general manager for Rand Mines, Ltd., has resigned and is returning to California next April.

T. W. WELLSTED has returned from a short holiday in the Mediterranean.

HORACE V. WINCHELL, who has been in Europe for three months, sailed for New York on October 1.

S. HERBERT WILLIAMS is here from Boston.

HERBERT C. WOOLMER is manager of the Spassky copper mine, in Siberia.

LEWIS T. WRIGHT, manager for the Mountain Copper Co., California, is in London.

JOHN YATES of Johannesburg has been paying a visit of inspection to the Shamva district, in Rhodesia.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Calculations of Percentages of Recovery.

The Editor:

Sir—In the August issue of your magazine we notice an article by T. J. Hoover entitled "Calculations of Percentages of Recovery," and also an editorial on page 91 commenting on the same.

We are sending you under separate cover a marked copy of our Ore Testing Bulletin, and we would draw your attention to the latter half of page 36. You will notice almost an exact duplicate of the formulæ referred to by Mr. Hoover. These formulæ have been used by us for the last six years. We have published it in both the first and second edition of our Ore Testing Bulletin under the head of "Mill Notes and Data." As the first edition of our Ore Testing Bulletin was published in 1907, you will note that there is nothing very recent in the discovery of the formulæ. It was given to Mr. J. M. Callow a number of years ago by a prominent engineer in this country.

We are taking the liberty of drawing your attention to this fact, as we think credit should be given our firm for having first brought this useful formulæ to the notice of the public.

The General Engineering Co.,
ERNEST GAYFORD,
Salt Lake City, *Secretary.*
August 30.

[A comment on this letter will be found in our editorial columns.—EDITOR.]

The Editor:

Sir—Supplementing Mr. Hoover's concentration formulæ, I beg to submit the following, which I have found valuable in determining the conditions favouring the most efficient running of dry screens, and which is original so far as I know.

Let x = Tonnage of ore treated.
a = Percentage of undersize.
y = Tons of undersize separated by screening.
z = Tons of discharge.
b = Percentage of undersize remaining unscreened in the discharge.

Then $100\frac{y}{x}$ = screening efficiency.

$$x = y + z$$

$$x\frac{a}{100} = y + z\frac{b}{100}$$

Multiplying the first equation by $\frac{b}{100}$ and subtracting we get $(a - b)\,x = (100 - b)\,y$

Thus the efficiency $100\frac{y}{x} = 100\frac{a - b}{100 - b}$

Thus by finding the percentage of undersize in the ore supplied and discharged, respectively, the screening efficiency may be found without reference to tonnage. Also if the tons discharged from the end of the screen be known, the tons fed and the tons of undersize after screening can be determined. The discharge can be diverted into a pipe and the stream caught periodically in a bucket, the time of filling being recorded; then, knowing the net weight per bucketful, the tonnage per 24 hours corresponding to any number of seconds can be read from a table. Or knowing the tonnage fed or the tons separated by screening, either of the other factors can be ascertained.

For instance, for a 16-mesh screen, if 75% of the ore and 15% of the discharge is *minus* 16 and the discharge is 20 tons per 24 hours; then the screening efficiency is 70·6% and the feed is 68 tons, of which 48 is separated by screening.

Those who have to struggle with 'return feeds,' that is, pulp requiring re-treatment, know how often material merely circulates while apparently the conditions for reduction are all right. A ten-minute test will readily show what a screen or set of rolls is really doing; also a few changes in speed or adjustment can be tried and variations in efficiency noted to good effect.

NOEL CUNNINGHAM.
Mercur, Utah, September 8.

Sulphuric Acid at Ducktown.

The Editor:

Sir—In an editorial in the *Mining Magazine* for July under the above heading it states that "it is easy enough to remove the dust by cooling the gases, but too much cooling is not desirable, because the Glover towers will not work efficiently," requiring a temperature of 150° C for denitration.

I have not had anything to do with making sulphuric acid from furnace gases, but I have had much experience with the settling of dust and fume. Having given that phase of the subject a great deal of study, some of my conclusions may be of interest. The idea that cooling is necessary for the separation and settling of dust from furnace gases is an old one, but a little consideration of the conditions

of dust settling should convince any one that it is absolutely wrong. Dust from blast-furnaces consists of particles of the charge carried over by the high velocity of the furnace gases and requiring simply time and a reduction in velocity for settling. The high temperature of the gases does not hinder the settling of these solid particles in the least; on the contrary, as the specific gravity of the gases is reduced much more by the temperature than that of the dust particles, a high temperature should materially assist in the settling of the latter.

The reduction of velocity is obtained by an enlargement of the flue, forming a second chamber, and it has been demonstrated that if the velocity is reduced to about 3 ft. per second there will be practically complete settling of the dust in less than 500 ft. in about 8 minutes. Probably the settling chamber could be made considerably shorter if precautions were taken to make certain that all the gases moved at the low velocity recommended, but to ensure the properties of diffusion, tubes on both the entrance and exit ends should be used, as I have pointed out, in the *Engineering and Mining Journal* for July 16 last. A simple inspection of the column of smoke rising several hundred feet above the top of a high chimney on a calm day should convince anyone of the necessity for this character of construction.

The foregoing has referred particularly to dust as distinguished from fume. The latter may be defined as metals and metalloids that have been actually volatilized in the furnace and pass out with the gases in an extremely minute state of division. This fume will vary in composition with the contents of the ore smelted and the condition of the furnace, temperature, etc., and consists chiefly of sulphur, carbon, oxides and sulphides of lead, zinc, cadmium, antimony, arsenic, selenium, tellurium, etc., with some gold, silver, and copper. Some of the oxides may be changed into sulphates by chemical combination with the sulphuric acid formed probably by catalytic action in the flues. While practically all of the dust will be deposited by a reduction of the gas velocity, the fume will not settle in any flue chamber within the reasonable limits of construction cost.

It is to be presumed that, when operating a furnace with a view to a production of sulphuric acid, it would be run with a hot top to secure the combustion of the volatile or 'free' atom of sulphur, and that therefore the fume would contain practically no carbon, sulphur, or sulphides, but would consist of oxides and sulphates of lead, zinc, cadmium, antimony, and arsenic with some associated gold, silver, and copper. The settling of all these except arsenious oxide ($As_2\ O_3$) would be favourably affected by the high temperature of the flue-gases, as none of them are volatile at any temperature permissible in flues. The volatilizing temperature of $As_2\ O_3$ is given by different authorities at from 190° C to 218° C, which is also well above the necessary temperature for the denitration of chamber acid. Fortunately for the Ducktown interests their ores do not contain considerable amounts of either of these fume-forming elements, and their problem is therefore reduced to its simplest form, as they only have to contend with dust and carbonic acid. Where fume-forming metals are present in sufficient quantities to prevent the successful use of Glover towers and direct conversion of the sulphurous gas into sulphuric acid by the chamber process, it may be possible to remove the fume in bag-houses or by modified Glover tower filtration, and the purified gases may then be treated either by the catalytic process or by reheating. This will undoubtedly prove to be a difficult problem to solve but where there is a market for the acid it will unquestionably be done sooner or later.

REDICK R. MOORE.

New York, July 29.

Dredging for Gold in New Zealand.

The Editor:

Sir—The published official reports on mining in New Zealand during 1909 show that the use of dredges in gold mining is declining, as is shown by the following table:

Year.	Number of dredges.	Value of production.	Average yield per dredge.	Number of dredges owned by registered companies.	Dividends distributed by dredges owned by registered companies.
1906	167	£505,199	£3025	66	£103,722
1907	128	419,634	3278	65	89,707
1908	123	373,818	3039	47	75,800
1909	111	327,676	2952	37	56,788

The profits made by privately owned machines is not available. The annual decline is explained as follows:

1. During the dredging boom nearly a decade ago, a considerable number of machines

were installed upon inadequate and unprospected areas. The life of many of these has been short.

2. The gradual exhaustion of the most accessible auriferous gravels, from which gold to the value of approximately £9,000,000 has already been won by dredging.

3. Preference for the hydraulic sluicing and elevating system for working flats formerly operated by land-dredges.

The first and second reasons require no further comment, but the third may be amplified by my stating that by sluicing and elevating (of which there are about 150 plants at work) a higher proportion of gold is obtained, the bottom is better cleaned; large boulders, timber, and hard seams are more readily overcome; there is less wear and tear and consequent expenditure on maintenance, and when the water supply is adequate (which it generally is in New Zealand) there is a larger output. In working cost there is not much difference between the two systems, the average cost by sluicing and elevating in New Zealand being well under two pence per cubic yard. The annual gold production by hydraulic sluicing plants has therefore increased as that from land dredges has declined. It has been stated that the legal dimensions of a dredging claim are so small in New Zealand as to prohibit the installation of a large dredge, but it will be seen from the following section extracted from the New Zealand 'Mining Act' that such is not the case and that the dimensions of a claim are liberal, although they prevent the 'shepherding' of large areas.

"In no case shall a claim of any description extend along or comprise more than one mile of the course of a stream or the foreshore of the sea-beach, such mile being measured in the case of the stream along the centre of the bed of the stream, and in the case of the foreshore along the foreshore at high-water mark;

"Provided that, in the case of a dredging claim, the limit imposed by this section may, with the consent of the Minister, be extended to a total of not more than three miles where he is satisfied that with the original limit the area for dredging is too small to justify the expense of acquiring a suitable dredge, and that the total area of the claim does not exceed seventy-five acres."

Dredging claims are now being worked in which the face of the gravel is 25 ft. below and 45 ft. above the water-level, the tailing being stacked at least 60 ft. above the water. The dimensions of the dredges now employed in New Zealand are shown in the accompanying table.

The modern large type of bucket-and-ladder dredge has been evolved by engineers of long practical experience after many and costly trials of other types. The conditions prevailing on New Zealand waters are abnormal, as regards high current velocity (as much as 12 miles per hour has been recorded in the Clutha gorge) large boulders, snags, rivers liable to high flood at little warning, also great variations in the depth of the uneven and rocky bottom; these, with other local features, render futile a comparison between New Zealand and American dredges, as argued in the London mining Press. The tendency in New Zealand is to increase the size of the dredges, to work the claims in a wide face, taking the good with the bad in preference to "picking out the eyes," and to continue the use of revolving screens, in preference to shaking tables which for a time were advocated and received a fair trial.

Of the 111 dredges in commission 7 are actuated by hydraulic power, 3 or 4 by electricity, and 2 by producer-gas; the remainder by steam-power. Each of these methods of obtaining the necessary power appears to give

Dredge.	Pontoons.			Ladder and Buckets.			Elevator.		Machinery		Approximate cost of dredge.
	Length.	Beam.	Depth.	Length.	Depth of dredging.	Capacity of Buckets.	Length.	Height above water-level capable of stacking tailing.	Boiler (N.H.P.)	Engine (N.H.P.)	
	Ft.	Ft.	Ft.	Ft.	Ft.	Cu. ft.	Ft.	Ft.			£
Otago No. 2	110	30	7	70	43	6	42	21	35 R.	20 R.P.	8,200
Alexandra Lead	117	35	6–7	63	40	4¾	114	57	40 P.	25 M.	12,700
Earnscleugh No. 3 (electric)	132	30	6–7	88	50	7	121	70	Electric power		...
Rising Sun	117	37	6–7	82	50	7	Centrifugal, 30		...	...	...
Electric (Lady Ranfurly)	109	25	7	75	50	6	Not required		20 Ro.	16 Ro.	6,000

satisfaction in the case to which it is applied. The average number of persons employed per dredge per day (of 24 hours) is 9; and the average working cost per week is £55 (at 52 weeks per year). The highest return by a land-dredge in one week was 248 oz. (fine) by the Waikaia dredge during April 1908. It is not my intention in this article to contend that the New Zealand dredge is an ideal machine, or that the gold-saving appliances are perfect, but that the men in New Zealand who for the past 25 years have been intelligently engaged evolving the present day bucket-and-ladder dredge of large type are more likely to understand the working requirements and limitations than those savants who seek for an impossible ideal and propose, among other things, to adopt concentrators and dredges of Dreadnought dimensions in narrow swift flowing mountain rivers and streams. In such cases the prospects do not warrant superfine and costly extraction or high capital expenditure.

FRANK REED.

Wellington, N.Z.,
August 15.

The Square Fathom.

The Editor:

Sir—Most of us might have hoped it would not have been necessary for engineers as a body to raise a protest against the innovation suggested by the technical advisor of one group of mining interests on the Rand, namely, that the 'square fathom' be adopted instead of the 'ton' as a quantity unit underground; but the fact that ideas promulgated without adverse argument may gain ground requires that individuals should protest against changes that do not make for advancement in simplicity and accuracy.

The relation of the tons extracted to the area stoped, when once the specific gravity of the ore mined is established, is a matter so simple that I would have thought that the reasonable desire to indicate on plans the area exhausted in the course of stoping could have been, as at present, attained by the simplest arithmetic calculations (aided by compensations for waste) without calling for revolutionary ideas embodying archaic units of area.

If mill reports could be made in terms of area instead of weight there could be some show of reason for adopting an area as a unit of quantity underground, but inasmuch as the total quantity of ore crushed, with its relation to slime, sand, concentrate and the precious metals, cannot be expressed in units of area, it is difficult to see why a disassociation should be established between the mine and the mill; especially when by so doing we must ignore the third dimension, namely, thickness of the vein.

I feel assured that the forcible protests of Messrs. C. W. Purington and W. H. Shockley in your August issue will find response in the minds of the majority of mining engineers. The metric system is so simple and comprehensive, and so much increasing in its application to mining, that anyone changing from the units of measurements in vogue in the country in which he is operating to the metric units would be counted on the side of enlightened practice, but to import the fathom into the calculations of an important industry is surely a step in the return to darkness and confusion. Fortunately, however, though the affairs controlled by the Wernher Beit group must be acknowledged as important, they do not constitute a large proportion of the mining of the world, and we may confidently expect that chaos will not spread.

It is significant that opponents of metric measurements, when arguing that in countries where the metric system is the legal standard of computation there is still an inevitable mixture of units, fail to state that these various units are imported by manufacturers and others from other countries still clinging to other units. The government of a country cannot by arbitrary enactments prevent A. B. & Co. of England or the United States from reporting, in their catalogues, the dimensions of wire ropes, for instance, in inches and eighths, or their plates in standard gauges (of which there are many varieties) but they can and do recognize in matters under their own control the universality of the standard they adopt.

This is rather going off the 'square fathom,' but if it provokes a wave of opinion that can carry the flood of metric measurements into all countries the digression may have been useful.

We may hope also that the opinion of the majority in the executive of the Institution of Mining and Metallurgy, an Institution labouring always on the side of accuracy, standardization, and common sense, will do something for the catholic adoption of the metre and its system, and keep in check innovations based on narrow interests.

WILLIAM CROSLEY.

Chihuahua, August 30.

Arsenic Fume.

The Editor:

Sir—The similarity of the chemical properties of arsenic and phosphorus compounds sug-

gests that the former, as the latter, may enter into plants by the action of the roots. Of the two closely related elements, namely, potassium and sodium, it is well known that plants prefer the former notwithstanding the greater abundance of the latter. Analogy does not help us, but the culture of plants in arsenical soils and subsequent analyses of these plants does, and constitutes the only reliable method. The Royal Commission on Arsenical Poisoning, 1903, made considerable experiments on these lines and came to the conclusion that only "minute" quantities of arsenic, and negligible for practical purposes, are absorbed by plants growing in arsenical soil. Dr. Luxmore's views are directly opposed to the report of the Royal Commission and call for consideration. Such views could only be arrived at either from the analysis of cultures (made in the laboratory or elsewhere) grown in soil taken from Brea farm (the damaged land) or from analysis of samples of grasses grown on the farm. As no evidence was tendered with respect to cultures, I should gather that the doctor's views depend solely on methods of analysis. Until Dr. Luxmore has published the methods by which he arrived at such remarkable conclusions I refrain from a more detailed criticism, but I do desire to express my entire disagreement with him.

H. W. HUTCHIN.

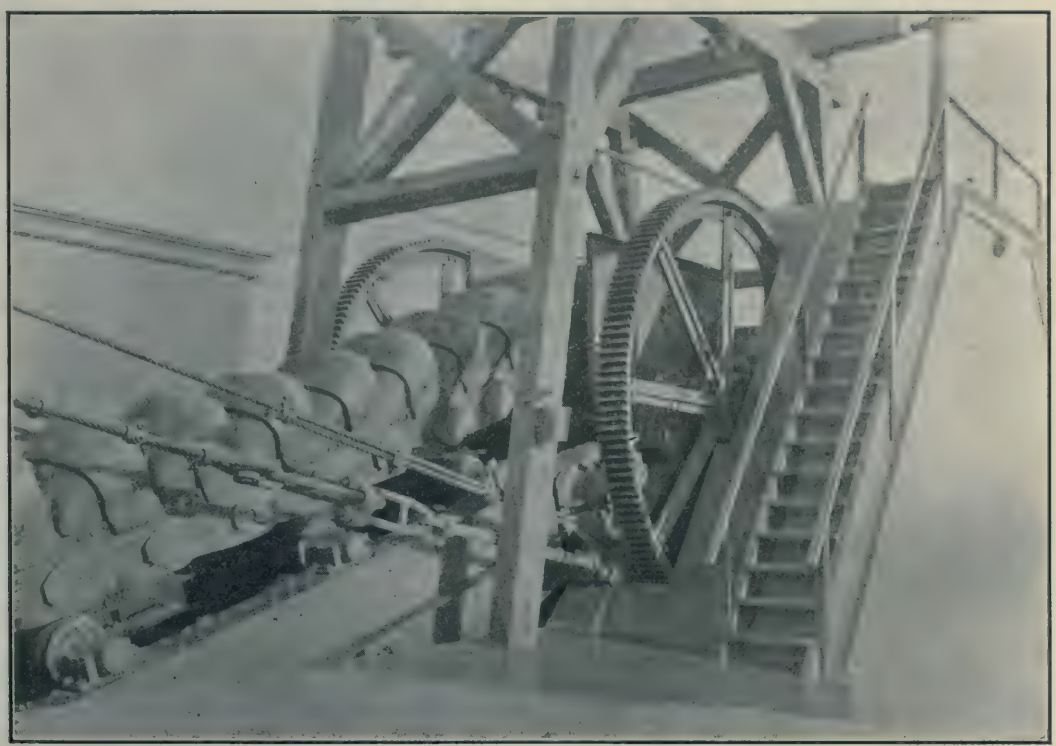
Camborne, September 28.

Dredging for Gold in West Africa.

The Editor:

Sir—As I have for several months been touring in the interior of West Africa, I have not had an opportunity earlier than this of perusing the recent numbers of your Magazine. During the past two years I have become largely interested in several alluvial propositions, and have had chances of conferring with some of the best and most practical dredging men. I am therefore tempted to add my perhaps inexpert word to this controversy.

I agree with you, Sir, if, in the leading article you published in January, you meant to infer that your original hope of abstracting valuable information from the contemporary correspondence by experts has been to an extent disappointed. You appear to have indicated, in the course of the leader referred to,



A CALIFORNIAN DREDGE, SHOWING STANDARD TYPE OF DRIVING-GEAR.

some of the many points which call for discussion but which do not get it, and you placed your editorial finger upon what are, after all, the essentials of dredging. Why, for instance, instead of endless talk about the respective merits of English and American dredges, which for reasons you have pointed out can never lead to any definite conclusions, do not these disputants tackle such questions as (1) the design and construction of buckets, (2) the virtue or otherwise attached to the open and close-connected bucket-chain, (3) the best method of handling heavy logs and boulders, (4) the most satisfactory way of gauging the amount of table-area required for certain types of buckets and ground, and (5) all the problems affecting the efficient screening, spraying, and separating of dredged gravel.

The subject of an efficient staff has also received too little attention. Mr. Goedkoop went too far when he dismissed a certain type of dredge-man as belonging to an "inferior class." If by that term he means the great number of fitters, engine-drivers, ex-sailors, and others who are engaged in the hope that they will soon 'pick up' the art of dredging, he surely overlooks the fact that not only do many of these men turn out splendidly but that it is always as well for obvious reasons to have a strong leavening of mechanics among a dredge-crew. Most of the best and most experienced dredge-men have received no proper mechanical training at all and have picked up their knowledge of engines and tackle in exactly the same way as the men of the "inferior class" are now being called upon to acquire a knowledge of gold-getting. Mr. Purington also goes rather too far when he infers that under no circumstances would he be guilty of manning a dredge with men that are described by Mr. Goedkoop as belonging to an "inferior class." These gentlemen should know that the great extension of the industry, and the consequent demand for men of dredging experience, who do not yet exist in anything like large enough numbers, renders the engagement of men of the fitter and mechanic class absolutely unavoidable. Again, in unhealthy tropical climates so many of these men either do one tour only or die during their term of service, that any big property must always, at the present stage of development, be a sort of training school.

Mr. Goedkoop is very near the mark when he says that "ground which can profitably be dredged for gold does not greatly vary from a certain type in any part of the world." The specific points of variance are (1) the existence of large stones and boulders, (2) the existence of heavy logs and submerged tree-stumps, and (3) whether the table concentrate is likely to be very sandy or not. The latter consideration chiefly affects the tables and gold-saving appliances. If the first two points of variance are emphasized to any great extent the only question that devolves upon them is the strengthening of the gantry, buckets, etc. After all, the only important root question for designers seems to be presented by the rough or easy nature of the ground to be dredged.

Owing, among other things, to the amount of timber in the West African rivers that country is one of the hardest dredging regions in the world. Yet in order to illustrate the amount of good achieved by discussions by experts such as have engaged in the present correspondence, I will take the case of two dredges on the Offin rivers, the property of the Ashanti Rivers & Concessions, Ltd., which were, I believe, built by Lobnitz & Co., *some six years ago*. They have, since being built, worked 132 hours out of 144 hours per week for weeks on end, and are doing so now. Mr. J. E. Hodgson, the Company's able and experienced manager, himself told me that practically his only trouble with them had been the constant danger of breaking the ladder, partly through the occurrence of heavy submerged timber and partly through such difficulties having to be occasionally tackled by inexperienced winchmen. In Mr. Hodgson's opinion, and he controls a fleet of 5 dredges, consisting of 4 different types and makes, the motto for designers should be 'Simplicity.' There are questions, such as the abolition or retention of the screen and elevator type of machine, that deserve attention, and the discussion of which by experts would be of infinitely more value to the industry than inconclusive claims and statements as to the relative merits of heavy or light English or American dredges.

THOMAS G. MARTIN.

Tarquah, September 6.

Drilling.—In the early days of dredging it was the custom to test 200 acres with 10 drill-holes; nowadays one hole to two acres is not uncommon. When results indicate that the gravel is of varying depth, that there are irregular channels or that the ground is spotty, it is not unusual to put down as many as one to three holes per acre, especially where no adjoining workings exist, such as throw light on any anomalous results from the drilling. The cost is a limiting factor, for each hole costs £12 to £20 in ground of any considerable depth.

THE COLLAHUASI COPPER DISTRICT, CHILE

By ROBERT HAWXHURST

General and Historical.—This interesting copper district is situated in the north-eastern part of Chile, within a few miles of the Bolivian frontier. It lies at an elevation of 15,000 ft., at the western end of that portion of the Andean tableland known as the Bolivian Plateau. The topographical features of the region consist of low rounded hills, precipitous dry ravines, and small valleys, opening out into flat, saline, and sometimes swampy plains, the beds of ancient lakes. To the north, south, and east, the volcanic peaks of the Andes rise to a height of over 20,000 ft., their conical slopes yellowed with solfataras and their dormant craters shrouded in mists of fumarolic vapour. Westward the country slopes rapidly to the arid nitrate deserts of the Tamarugal plain, and thence to the Pacific coast.

The hills are barren of vegetation, being far above timber-line. The only plant hardy enough to withstand the rigour of the climate is a species of giant fungus *(fungus cordillerensis)*, which constitutes the fuel of the district. Among the indigenous four-footed animals may be mentioned the guanacos and vicuñas, found in the sheltered ravines, and viscachos and foxes on the rocky hillsides. Of birds, the condor is ever present; cranes and ducks frequent the swampy marshes, and grouse and larks visit the highlands during the summer.

Parts of Chile and Bolivia.

The climate is cold and bleak, the temperature ranging from 10° to 60° F. with a mean of about 35°. During June, July, and August snow falls to a depth of from 2 to 6 ft. and fierce blizzards rage for days at a time. Violent winds are of frequent occurrence throughout the year, the gales sweeping over the saline plains with an almost arctic chill. The rarefied atmosphere at this elevation throws an undue strain upon heart and lungs. Any ordinary effort becomes a violent exertion and causes an acute beating of the heart. In the case of new-comers, days and often weeks pass before the body adapts itself to the conditions.

The district is reached from the Chilean ports of Antofagasta and Mejillones by means of the Antofagasta & Bolivia Railway, an English company operating 700 miles of narrow-gauge railway between Antofagasta in Chile and Oruro in Bolivia. From Ollague, a station on the main line, a branch 50 miles long has been built into the Collahuasi district and was opened for traffic in 1908. The Collahuasi

branch is the highest railway in the world, attaining an elevation of 15,809 ft. above sea-level. Excellent freight and passenger services are maintained. The night express reaches Collahuasi in 24 hours from Antofagasta, a distance of 330 miles.

Numbers of ancient copper tools, found in old workings, prove that the ore desposits of the district were exploited before the advent of the Spaniards. Ruins of ancient smelting furnaces are still to be seen and fragments of matte are frequently found in their vicinity. The region is described by early Colonial writers, and more particularly by Father Barba, a Spanish priest, who wrote at the beginning of the seventeenth century and who gave the locality the name of Peirira.

Gold and silver, as well as copper, were mined by the ancients. The remains of bygone sluice-ways, paved crushing-floors, and mills formed of huge rocking boulders are to be seen in the Chiglla and Poto canyons. Collahuasi, however, was abandoned in early times and it was only in 1896, with the great growth of the copper industry all over the world, that attention was again drawn to this district.

In 1899 the Compañia Minera de Collahuasi was formed, owning 28 claims with an area of 350 acres. At the outset the results obtained by this company were far from satisfactory, but after the discovery by Tiberius Pergolesi of the lode that bears his name, the state of affairs changed. Ore carrying as much as 40% copper was found almost at the surface and in a short time the company was mining and shipping 500 tons of ore monthly, averaging 35% copper and carrying appreciable gold and silver contents as well. A wagon-road was built to Lagunas, on the Nitrate Railway, 90 miles away. Ore was shipped to this point in mule carts and thence to the port of Iquique by rail. All supplies were transported over the same road. Notwithstanding the excessive cost of transport the high price of copper ruling during 1906 and 1907 enabled the Company to conduct its operations with highly remunerative results. New properties were acquired until the total holdings amounted to over 3000 acres and a vigorous campaign of prospecting was started, with promising results.

With the advent of the railway, shipments were increased to a monthly output of 2000 tons of ore carrying 20% copper. The ore is shipped by rail to Antofagasta and thence by steamer to Europe.

Discoveries of rich ore, together with the better price for copper, led to the formation of numerous mining companies with properties in Collahuasi, so that in 1906 the local mining activity was at its zenith. Notable among the new companies was the Collahuasi Syndicate, which became the parent of the Compañia Minera Poderosa de Collahuasi and the Compañia Anglo-Chilena de Collahuasi. Other Chilean companies organized at the same time were the Blanca Torre, the Esperanza, the Santa Jovita, Condor, Las Marias, Cerro de Pasco, Las Borrachas, and La Riqueza. Much prospecting was done but serious mining operations were confined to the Poderosa, Collahuasi, Esperanza, Blanca Torre, and Santa Jovita Companies, named in the order of their importance.

The Poderosa speedily took the lead both in quantity and value of ore shipped and in the amount of its ore reserve. With the decline in the price of copper, financial interest waned, until at the present time only the first three companies named are carrying on active operations.

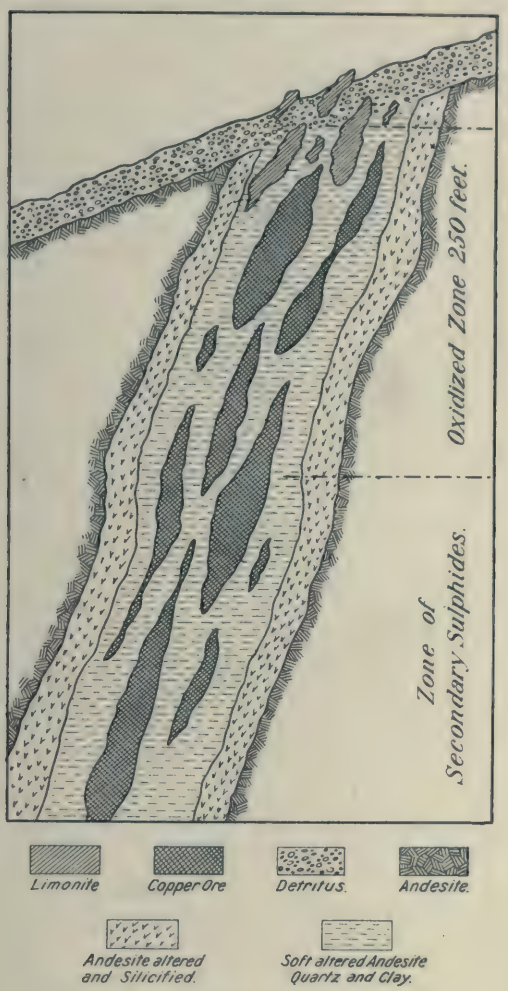
The bulk of the labour employed in the district consists of Quichua and Aymara Indians, from the neighbouring republic of Bolivia. Although largely born to pastoral pursuits, these men take kindly to mining, and while their individual efficiency is but one-half that of a white miner, wages are more than correspondingly low. Of late years increasing activity in railway construction in Bolivia has furnished these people with remunerative occupation at home and they have become less inclined to seek employment in Chile. These miners work single-handed in 10-hour shifts and, having been born on the plateau at an elevation of over 12,000 ft., are but slightly affected by the rarefied atmosphere of Collahuasi. They make fair mechanics, carpenters, and smiths. The average rate of wages in the district is as follows:

Foremen.....	£15 per month and found.
Timber-men..	£10 per month and found.
Miners.....	5 to 7s. per day.
Trammers....	6s. per day.
Carpenters....	8 to 10s. per day.
Blacksmiths..	8s. per day.
Labourers....	5s. per day.
Boys and women for sorting ore, and sewing and marking bags	3 to 5s. per day.

The Bolivians are peaceable and easily managed. The outbreaks of lawlessness and disorder that from time to time occur in the district can usually be traced to Chilean or foreign agitators; an excellent service of mounted police maintains perfect order. As happens in all the Latin-American republics, regular work is greatly hindered by the prolonged cele-

bration of national holidays and festivals.

All mining supplies, coal, timber, food-stuffs, and building materials are brought from Antofagasta by rail. With the exception of a few Chilean and Bolivian food-stuffs, all of these are imported from abroad. Beef comes on hoof from the Argentine and sheep are driven from Bolivia. The railway tariff is high



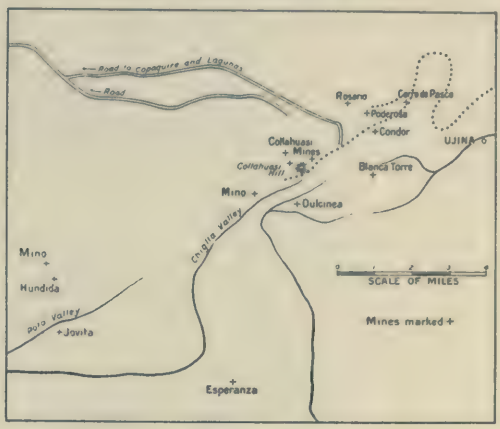
Typical Orebody at Collahuasi.

and heavy losses from robbery in transit are frequent, in consequence of which supplies laid down at the mine are extremely costly.

Geology and Ore Deposits.—While the known mineralized zones are contained in an area about six miles square, with Collahuasi hill as its central point, the district is of greater extent, with rather indefinite limits. The entire region is one of decided volcanic origin. The lavas and tuffs consist mainly of varieties of andesite, diorite, and dacite, with occasional intrusions of diabase and gabbro. Quartz is present in varying quantity, but it appears to be secondary and to have common origin with the copper-bearing lodes. The general strike of the country is north, with a dip west.

Denudation of the country has been intense, the rugged peaks of the Andes having been planed down into low rounded hills. The mountains, devoid of vegetation, have offered a bare surface to the weather, and the mechanical actions of melting snows and heavy hail-storms has been greatly assisted by the extremes of temperature and of moisture as well as by earthquakes which, though slight, are of frequent occurrence.

Over the surface of the district the andesite is decomposed in place to a depth of from 2



Collahuasi Mining District.

to 30 ft., varying with the nature and texture of the rock. With the denudation of the country, secondary enrichment has taken place under the most favourable circumstances. Faults and fissures are numerous, the latter giving rise to the copper veins.

Outcrops are seldom seen by reason of the mantle of detritus that covers the country. However, in a few favourable localities the lodes are marked by masses of quartzose residue, stained with hydrated iron oxide and copper carbonate.

The lodes are fissure-veins, striking and dipping with the andesite country. Hydrothermal action has completely altered the rock in the vicinity of the fissuring. Alteration is greatly intensified in the case of rock included between the lode and a feeder, and this material is often rich is copper; but in no case has the altered rock of the walls been found to carry enough copper to constitute ore. Faults have played an important part in influencing ore

deposition and when the sulphide zone is reached it seems probable that workable orebodies will be largely confined to the proximity of fault-planes. Up to the present time the mine workings have failed to penetrate the zone of secondary enrichment.

The orebodies occur as irregular lenses and lenticular masses, lying parallel to the fissures. They vary in size from mere pockets to lenses whose axes attain a length of 100 ft. or more, with a maximum thickness of 50 ft. Surrounding the ore, the vein-matter usually consists of soft altered rock, light in colour, and frequently stained with carbonate, silicate, and sulphate of copper. In shattered and disturbed portions of the lodes the vein-filling becomes a stiff clay, from light red to dark gray in colour. Large bodies of quartz are associated with the ore only in the lodes of Collahuasi hill. Numerous feeder-veins are found, increasing the copper content at the contact, but pinching and decreasing in assay-value rapidly as the distance from the main lode increases.

Chrysocolla, bornite, chalcocite, and cuprite are the characteristic ores of the district, but chalcopyrite, melaconite, azurite, malachite, brochantite, atacamite, tetrahedrite, and native copper are common. Local occurrences of native gold and silver, in proximity to fault-planes are by no means unusual. The carbonates, silicates, sulphates, and oxides of copper prevail in the upper levels, being largely replaced in depth by bornite and chalcocite.

The water-level has not been reached and it is evident from the nature of the mineralization in the lowest workings that the zone of secondary enrichment will extend much deeper that at present.

A general analysis of the average ore of the district is as follows:

	%		%
Copper	18	Alumina	12
Iron	3	Lime	2
Sulphur	3	Silver	6 oz. per ton.
Silica	52	Gold	Occasionally present.

Poderosa.—The properties of the Poderosa Mining Co. are situated in the eastern portion of the district along a lode, or line of deposits, for 5000 ft. along the strike, which has a direction of 40° west and an average dip of about 70° south-west.

Three ore deposits have been proved and developed along this lode. At the San Carlos mine at the southern end, the shaft is 450 ft. deep and the ore has been proved over a horizonal range of 350 ft. Adjoining this is the Poderosa with a depth of 500 ft. and a range of 1200 ft. Four thousand feet northward the Rosario mine had a depth of 225 ft. and a horizontal extent of 475 ft. All three mines are in ore at bottom. The total extent of the workings amounts to over 20,000 linear feet.

Owing to the faulted and disturbed nature of the lode, the distribution of ore is irregular. The width of the workable orebodies varies from 12 inches to 30 ft., with an average of about 4 ft. Parallel lenses exists both east and west of the known ore and much cross-cutting will be required to explore the ground properly. The ground throughout this lode is heavy and treacherous, necessitating careful timbering in stopes, levels, and shafts. The ore has increased in value from the surface to the fifth level, the average from the Poderosa and San Carlos being 24% copper. In the Rosario mine the ore is of lower grade and averages 15%. The sulphide zone has not yet been penetrated and further development in depth at the three mines promises to disclose large bodies of rich secondary ore. Up to 1909 the reserves were maintained at from 90,000 to 100,000 tons of 24% ore. Reports a year later indicate a greatly reduced tonnage.

The working costs during the past have been high, amounting to as much as £6 per ton of ore placed on board steamer at Mejillones. With the new plant in operation, a more reasonable railway freight-rate, and a reduction of excessive agency charges and commissions, costs should be greatly reduced.

During the past three years, the mine has shipped to smelters 60,000 tons of ore averaging 23% copper and 7 oz. silver per ton. In 1908 the company paid a dividend of 25% upon a capitalization of £240,000. In 1909 the property was sold to an English company and the capital increased by watering to £500,000. In an ill-advised attempt to create a speculative market for these shares, the financial affairs of the company were grossly mismanaged and a most promising property was brought to the verge of ruin. No working capital has ever been provided for the Poderosa mines, all the improvements and new plant having been paid for out of earnings.

Collahuasi.—The properties of the Compañia Minera de Collahuasi, aggregating 3000 acres, are situated in the centre of the district, encircling and including Collahuasi hill. Five important deposits have been worked in the lodes that radiate from this hill, namely the Don Eduardo, Pergolesi, Esperanza, Anita, San Nicholas. The Don Eduardo, Pergolesi, and Esperanza mines have attained a depth of about 450 ft.; the Anita and San Nicholas are

not so deep. As in the Poderosa mines, the veins are much faulted and the distribution of ore is irregular. The ores differ from those of the Poderosa only as regards the gold content, which averages over 5 dwt. per ton. In 1909 the reserves were reported at 60,000 tons of 23% ore and it is probable that they have been maintained at about three figures.

STEEL HEAD-FRAME AT PODEROSA.

The principal shafts are equipped with gasolene and steam winding-engines, but in general the mechanical equipment is antiquated and inadequate. Working costs are lower than at the Poderosa for several reasons: the mines are dry and there is no pumping expense; the wall-rock is so firm as to require but little timbering, and the wider veins permit of cheaper stoping. Ore is placed on board steamer at Antofagasta at a cost of less than £5 per ton. During the past three years the company has shipped about 50,000 tons of 23% ore. Previous to the completion of the railway, shipments of high-grade ore were made to Iquique by mule-cart.

The Compañia Minera de Collahuasi is a Chilean Corporation with a capital of $2,000,000, equivalent to £100,000. Up to April, 1909, 75% in dividends has been distributed and $100,000 carried in reserve. The property is

in strong hands, being almost entirely owned by a family of Peruvians, resident at Iquique.

Esperanza.—The properties of the Esperanza company, situated on the southern border of the district, five miles from the Pergolesi mine, consist of 14 claims, with a superficial area of 285 acres. Two deposits have been opened up to a depth of 180 ft., disclosing wide strong veins, which invite further development. The ore occurrence is typical of the district, being extremely pockety and varying greatly in copper content. The average width of ore is about 3 ft., with an average assay-value of 20%. The underground workings amount to 1800 ft., all in the oxidized zone. Ore developed amounts to 7000 tons averaging 20% copper. Work is at a standstill, the owners presumably awaiting a higher price of copper to stimulate interests sufficiently to provide funds for further development.

Blanca Torre.—The property of the Blanca Torre Mining Co., situated 1½ miles south-east of the Pergolesi mine of the Collahuasi company, consists of 21 claims, comprising an area of about 260 acres. The formation is andesite intruded by numerous basic dikes and the vicinity shows signs of great disturbance. Numerous small veins outcrop near the Desiada shaft, striking north-westerly, in conformity with most of the lodes in the district, but dipping flatly eastward. As is usual in Collahuasi the outcrops consist of low-grade carbonates and silicates. The mine has been opened to a depth of over 250 ft. and the Desiada shaft and adjacent workings have disclosed several small veins, from 2 to 10 inches wide, of varying dip and strike and assaying from 2 to 25% copper.

Water came in at the bottom of the shaft and a tunnel was driven through the hillside for a distance of 1000 feet to drain this. In its course 6 small veins were cut, each showing traces of copper. The existence of these clusters of veinlets, within a restricted zone, would indicate that they are feeders to a larger body of ore in the neighbourhood, the search for which should be continued.

The Santa Jovita Mining Co. owns a group of 31 claims, covering an area of 380 acres, situated on the south side of the Poto canyon, six miles south-west of Collahuasi hill. The rock here is diorite, intruded by basic dikes, with a general northerly trend. Gossan outcrops of limonite are of frequent occurrence and are stained with the oxides of iron, manganese, and copper. This locality differs from the central Collahuasi district, where both country rock and intrusions are more acidic.

The several claims have been prospected by means of shafts and inclines, the Anita mine being the deepest, with 250 ft. of shaft. Results have been most disappointing and operations have been abandoned. While veins near the surface return as much as 10% copper, these speedily pinch and become impoverished.

Hundida.—About a mile to the northward of the Santa Jovita are the ruins of the buildings of the Hundida mine, a gold mine that was worked in the early nineties. The vein is in diorite and consists of quartz with oxides of iron and manganese, carrying gold and silver,

A few grab-samples from ore still adhering to the walls returned 2 dwt. gold and 18 oz. silver per ton, but pockets of rich ore are reported to have been found in the old days. The workings are numerous but shallow, about 100 ft. being the greatest depth attained. Caving prevents an examination of the bottom.

The Anglo-Chilean Co. with a capital of £200,000, formed by the Collahuasi Syndicate, the parent of the Poderosa company, owns 8 groups of claims in the Collahuasi district, with an area of 450 acres. A small amount of exploratory work has been accomplished upon the Dulcinea, Asunta, and Gales properties and pockets of ore carrying as much as 16% copper have been found.

Other Mines.—One mile south-east of the Poderosa shaft is the property of the Condor company, apparently situated upon the southern extension of the Poderosa lode. The shaft is 200 ft. deep and levels driven at depths of 80 and of 146 ft. have exposed a vein dipping 70° south-west and striking 35° west. The average width is 2 ft. with a copper content of 18%. The ore is principally chrysocolla, with some malachite, bornite, and chalcocite. The vein occurs in andesite, a few hundred feet to the eastward of the diorite intrusion. This mine promises well, but development is desultory.

To the north-east the Poderosa property adjoins the claims of the Comunidad Cerro de Pasco, some 20 in number. A prospect-shaft on the Margarita claim has cut a good vein at a depth of 40 ft., returning 12% copper. No work has been attempted for several years.

Throughout the remainder of the Collahuasi district the hillsides and valleys are dotted with waste dumps, marking the openings of prospect-shafts and tunnels. While these workings have frequently disclosed veins of a fair grade of ore, considering the shallow depth to which they have penetrated, the properties have been abandoned, as far as active operations are concerned, their owners seemingly being content to hold title by annual payment

of 10 pesos per hectare, which is the only requirement of the Chilean mining law.

General Considerations.—The two producing properties, the Poderosa and the Collahuasi, are shipping monthly about 4000 tons of 20% ore. This is mined, sorted, crushed, and shipped to the coast by rail, for transportation by steamer to the United States and Europe. No local smelting has been attempted and at the present time it is doubtful if such an operation could be conducted successfully because of the excess of silica in the oxidized ore, the absence of necessary fluxes, and the high cost of coke. However, should the sulphide zone prove productive, the question of local smelting will have to be faced, as the lower grade of the sulphide ore would not permit of transport to smelters abroad.

The future of the district will depend, of course, almost entirely upon the market price of copper, but other factors will influence this as well. Power-drills should largely do the work of the old single-handed miner; underground exploration should be hastened by means of diamond-drills; electric power for the operation of the plant should be brought from the rapids of the Loa river, and labour-saving machinery should be utilized wherever possible.

Mino Silver Mines.—Any description of Collahuasi would be incomplete without reference to the Miño mines, which were worked for silver many years ago. Six mines, known as the Hallada, Pascua, Montezuma, Rubicon, Navidad, and Trinidad, are situated in Chiglla canyon, from one to three miles south-west of Collahuasi hill. The Zulu and Condor mines are farther westward, in the neighbourhood of the old Hundida mine. On the head-waters of the Loa river, 25 miles from Collahuasi, is the mill and power-plant.

The area in which the Miño deposits occur is diorite intruded by huge dikes of porphyry, gabbro, and basalt. The lode, which carries both gold and silver, can be traced for a distance of six miles, striking north-east and dipping northward. The vein outcrops in places to a height of 30 ft. and for a width of over 40 ft. The ore consists of quartz, with oxides of manganese and iron. The manganese occurs as psilomelane. Gold and silver are found native. Copper and lead appear in small quantities.

VOLCANO OF OLLAGUE.

The mines were opened up by scattered workings. About 20,000 tons of ore were mined and shipped by mule-cart to the mill on the Loa. Here it was put through a 5-stamp mill and passed thence to the amalgamating pans. It is reported that the ore so treated returned an average of 80 oz. silver and 2 dwt. gold per ton.

Presumably the falling price of silver would not permit of work at a profit, with the primitive means at hand, and in 1894 the mines and mill were closed. Today they form the haunt of bat and owl.

Although the old workings proved the vein to a depth of but 100 ft., its great extent as shown by miles of outcrop suggests the existence of a vast tonnage of ore, which, with the improved transportation facilities, might be worked at a profit by modern methods.

THE TREADWELL MINES

IN our February issue we gave some notes describing the large operations of the important group of gold mines at Treadwell, on Douglas Island, Alaska. Since then the shares in the three companies have risen in response to the improved yield and better prospects. The Alaska Treadwell, Alaska Mexican, and Alaska United are among the best examples of the winning of money from large deposits of low-grade ore and in their technical management they afford an example well worthy of careful study.

TREADWELL, ALASKA.

In a general way the mines are still behaving well in depth; so far as the physical situation is concerned, a life of fully 10 years is practically assured, with every promise of the ore-shoots or pipes holding their value in depth, as stated in our February issue. Increasing depth demands constant additions of plant and power and is thereby forcing the management to incur heavy expenditures in order to maintain the margin for profit. We are informed that the plans for equipment call for an expenditure of $1,200,000, $400,000 of which has already been taken out of surplus earnings, while the remaining $800,000 will have to come out of earnings during the next three years. The items are as follows:

1. A central hoist or winding plant, together with a crushing plant and distributing system to the four big stamp-mills. This will cost $200,000. The hoist will have a capacity of 5000 tons in 20 hours from a depth of 2500 ft. The skips will hold 5 tons each and take much larger pieces of ore than it is possible to get out of the mines through the existing shafts. This will save some expense in the 'bulldozing' or blasting of big pieces of ore.

2. A 2000 hp. hydro-electric power-plant with steam auxiliary, to cost $220,000. This will furnish all the electricity needed for lighting and for supplying small scattered power-

units underground and on the surface, all of which are now operated inefficiently by steam-power.

3. A reservoir, pipe-lines, and water-wheels. This requires $130,000. A big dam has already been constructed in the hills behind the mines. This plant will furnish water-power for practically the whole of the year for the Alaska Mexican and Ready Bullion mills, thus saving the present use of steam-power for about seven months each year.

4. A cyanide plant and refinery, which will cost $150,000. Arrangements have been made to cease shipments to the Tacoma smelter and to treat all the concentrate in this cyanide plant at a saving, estimated as follows: Present freight, with direct and indirect treatment charges, $10·50 per ton. The same work will be done on the mine at a total cost, including treatment losses, of $4·50; a saving $150,000 per annum or $6 per ton of concentrate.

In addition to this the cyanide residue will have the following commercial value per ton: Sulphur contents, 40%, worth $5 per ton; iron contents, 40%, worth $3·20 per ton; gold, about $1·50; making a total of $9·70 per ton, or a realizable value, when a market is found, of about $150,000 per annum.

5. A compressor, equal to 50 drills, with a new powder and oil wharf and central salt-water pumping-plant, at a total cost of $100,000. The additional air-compressor capacity will aid the air pressure required for the 120 machine-drills now in use. The wharf is intended not only to economize the handling of supplies, but also to reduce the risk of life and property in so doing. The central pumping-plant is designed to furnish a constant and reliable supply of salt water for the mills at all times. Each mill has its own salt-water pumping-plant; but when in use in the winter the suction-pipes of these plants are broken by icebergs.

6. A 3000 hp. hydro-electric plant, to cost $400,000. When this hydro-electric power-plant is completed, the mines will have cheap power, rendering it economical to begin filling the stopes and openings with mill-tailing and eventually recover portions of some of the pillars of ore that are now left for safety. Spare electric power will be available for the 300-stamp mill, so that the monthly returns of the Treadwell company can be made more uniform. Also it will be possible eventually to weight all the stamps in order to get increased crushing capacity and thereby work the mines harder and faster under the same fixed expense, that is, exhaust them at the rate of 150 ft. in depth per annum instead of 80 to 100 ft., as is now being done.

Map of South-eastern Alaska.

CYANIDATION AT THE ALASKA-TREADWELL

By T. A. RICKARD

[*The following notes were made during a journey through Alaska in the summer of 1908; they are interesting now because it is announced that a cyanide plant and refinery is to be erected.*]

AT Treadwell for many years it has been the practice to subject the ore to stamp-milling, amalgamating the free gold and collecting the gold-bearing pyrite in the form of a concentrate. The four mills belonging to the Alaska-Treadwell, Alaska-Mexican, and Alaska United companies produce per day only about 100 tons of concentrate, or, to state it more accurately, the ore crushed by the 880 stamps yields 85 tons per day. This concentrate has an assay-value of $60 per ton. At one time the concentrate was treated on the spot by chlorination but the needs of the Tacoma smelter and the consequent low rate offered for treatment led to the shipment of this pyritic material. It goes to Tacoma in barges holding 1000 to 1400 tons apiece. The concentrate contains from 9 to 11% silica. The charge for treatment is satisfactory, but the management considered it wise to make experiments with cyanidation so as to have an alternative in case the smelter rate should become excessive. According to contract, the concentrate must go to the smelter at Tacoma, but a portion of the gold can be extracted before shipment by subjecting the material to re-grinding and leaching.

A cyanide annex has been built just east of the Mexican shaft-house. To commence, a 10-ton plant was erected, this being a complete unit such as could be multiplied to treat 100 tons of concentrate. The material to be cyanided will be taken from the mill in cars pulled by oil-burning locomotive and hauled to the foot of an incline leading to the top of the cyanidation building. The experimental plant will have an Abbé tube-mill, 4 by 14 ft.; then an amalgamating table 24 ft. long, so placed as to be readily adjustable as to gradient; at the foot of this is a trap to catch amalgam; then follows a settling-vat, 4 ft. diam. and 8 ft. deep, with a 20° cone-bottom. When enlarged, the 100-ton mill will be similar; it will contain two tube-mills and a 30 ft. settling-vat. The contents are taken through a 6 in. pipe on a 4% grade to the agitator-vats. These are two in number, of 10 ft. diam. and 13 ft. deep, with 45° cone-bottom. They will be made of steel, agitation being effected by compressed air, and they will be operated by 2 hp. apiece. Below the agitator-vats the pulp descends to a mechanical settler (14 ft. diam., 10 ft. deep) with an arm-agitator; from this settler the main flow goes to a Butters vacuum-filter, and thence to a Merrill or an Evans filter-press. Finally, precipitation of the gold is effected on zinc-dust. It is possible that Pachuca tanks may be used after the settling-vat. It was decided to use amalgamation below the tube-mill because Walter L. Brown, who is in charge of this experiment, ascertained that there was some coarse gold in the concentrate; also at the bottom of the agitator-vat he found (before amalgamation was added) 1% of stuff that assayed between $800 and $1200 per ton.

Many experiments preceded the erection of this little cyanide annex. Mr. Brown found that after re-grinding the amalgamation of the concentrate gave 65 to 67% extraction of the gold. This proved that the gold was free. The re-grinding was done in a clean-up barrel, using beach pebbles and pulverizing to 200 mesh. The actual recovery exceeded the theoretical extraction as determined by the difference between the original and the refuse. The solution varied from 0·12 to 0·4% KCy, but the results did not differ appreciably, although the loss of cyanide, of course, was less when using the weaker solution. Tests on roasted concentrate proved that roasting was no help. It is a question whether the concentrate-slime can be filtered by the vacuum method. A sample of pulp in suspension on the top of the agitator-vat gave as low a tailing as the pulp after impoverishment by amalgamation; but this proved misleading, for, on further investigation, there was found a coarse very rich deposit at the point of the cone of the agitator-vat, caused by settlement of gold too coarse to be dissolved in the cyanide solution within the limits of the time and the strength of solution adopted in these tests.

Apart from the question of cheaper metallurgical treatment, it is obvious that the cyanidation of the concentrate will obviate the delay due to shipment by sea to Tacoma.

DEEP MINING AT BENDIGO

By WILFRED J. RICKARD

GOLD ore has been mined at Bendigo from the surface to a depth of 4600 ft., not from one continuous fissure but from a series of 'saddle reefs' having a dip eastward averaging 1 in 14. The distance between the successive saddles ranges from a few feet to hundreds of feet, and there is no rule to indicate at what depth the next saddle may be found. There are 13 known 'lines of reef' or lodes in the district; they are parallel to each other and extend for a maximum length of 14 miles.

IN THE VICTORIA REEF QUARTZ MINE, ON THE 4154 FT. LEVEL.

The deepest gold mine in the world is the Victoria Reef Quartz situated centrally on the famous New Chum lode, from which several million ounces of gold have been won. The Victoria Reef Quartz has attained a depth of 4600 ft. and at that depth large bodies of quartz are exposed, but unfortunately this is not pay-ore, for, although a little free gold has been detected, a crushing has proved its value to be only 1 dwt. per ton. It is the company's intention to continue to sink to a depth of 5254 ft., assisted by the Government, which is bearing half the cost. The directors are to be complimented on their determination and energy in testing the deep ground. A good shaft, a powerful winding plant, and other machinery expedite this important undertaking

A massive formation 40 ft. across the saddle was mined above the 4254 and 4154 ft. levels, from which many profitable returns were obtained. The best mill-run yielded 17 dwt. per ton, but the average was poor. From this reef and the spurs associated with it some coarse gold was obtained. Many pieces turned the scale at half an ounce after having gone through the battery, thereby clearly showing that the character of the gold is not changing. It has often been stated that as great

depth is attained the gold would be found in finer particles, but the evidence is to the contrary. Nor is there any loss of purity.

The heat of the rock and water increase with depth. A sample of water was taken out of the ground at a temperature of 114° F and the analysis given by the Government is as follows:

	Grains per gallon
Sodium choloride	91·5
Sodium sulphate	5·3
Sodium carbonate	2·6
Lime carbonate	8·7
Magnesium carbonate	3·2
Silica	1·5
Alumina and Iron oxides	0·2
Total inorganic solids	113·0
Volatile and inorganic solids	0·0
Solid in suspension	0·2

This sample was taken at a depth of 4280 feet.

The alternate beds of sandstone and slate are all conformable to the rock penetrated by the upper workings, they are of the same character, and maintain the same structural characteristics. The only difference perceptible is that the cleavage is more pronounced, with a slight easterly dip, and the bedding planes are corrugated one in the other. The lava dike still continues its course in close proximity to the anticlinal axis.

It is possible to continue mining at great depths at a reasonable cost. For instance, the Victoria Reef Quartz shaft was sunk below the 4000-ft. level for £5. 16s. per foot, including everything from the stoke-hole to the dump. The greatest item was £1. 5s. per foot for firewood. No other work was being done at the time. This meant that the sinking bore the cost of keeping the mine unwatered; if other work had been in progress the cost proportionately would have been less. Given a lode of average size the cost would not exceed 16s. per ton to raise and crush the ore. The whole working expenses of the mine should not exceed £1 or 5 dwt. per ton. This cost is sufficient to permit of prospecting adequate to compensate for the depletion of reserves.

The heat is a matter for special study. The temperature of the rock is about 112° F and the water issues at 114° F. This makes the air too hot for manual labour and unless a sufficient volume of fresh air is conducted to the face operations cannot be performed with any speed. Water-jets have been tried, but the current of air rapidly becomes humid and vitiated. Steam is visible rising from the ground. The best device for ventilation yet adopted is an overhead brattice, by which 1500 cu. ft. of air has been conducted to the face and the temperature lowered 25°. This system gives air that is both cool and pure. From practical observations I conclude that the air reaches the bottom level at a temperature of 75° and is warmed to the extent of 1° for each 100 ft. in length of underground passage traversed, with a gradual less rise as the temperature increases. The air thus circulated will be found to have a lower 'wet bulb' register than by any other means and is less injurious to the miner. It is obvious that to ventilate a mine having a large number of working-faces a big volume of air must be supplied in order to work economically.

Silver Ore from the Crown Reserve mine Cobalt is now being shipped to Germany where it will be mixed with the low grade ores from Saxony and treated at the Government smelting works.

Complex Tin Ores.—In British Patent 9397 of 1909, Donald M. Levy, lecturer on metallurgy in Birmingham University, describes a method of recovering tin from complex ores. The process is similar to that used for obtaining arsenic from 'hardhead,' which is a metallurgical product in tin-smelting consisting essentially of sulph-arsenide of iron with other metals present. The process involves the expulsion of the arsenic by means of a bessemerizing blow. Mr. Levy finds that this bessemerizing process will also remove the tin oxide. If there is no arsenic and iron in the tin ore or other product to be smelted, he adds sufficient to make it possible to produce a speiss in the blast-furnace. The speiss is subsequently bessemerized, and the mixed oxides of tin and arsenic thus obtained are separated from one another by sublimation.

Sintering Ores.—Carl Dellwik, of London, describes in British patent 13,073 of 1909 a machine for sintering fine ores. The ore is fed upon a conveyor which travels slowly through a furnace. The layer of ore is made sufficiently thick to prevent the sintering action from penetrating right through it. Thus at the end of its travel through the furnace the sintered ore is easily detached, as there is still some of the unaffected ore beween it and the bed of the conveyor. This arrangement also has the advantage that the conveyor is not damaged by the heat or by the chemical reaction of the sintering process. When the conveyor arrives at the end of the furnace the ore is discharged upon a screen. This separates the untouched fine ore, and delivers it to a belt which carries it back to the changing end of the furnace.

OIL IN MEXICO

By SYDNEY A. R. SKERTCHLY

IN view of the continued attention being paid by promotersand capitalists to the exploitation of petroleum lands on the Gulf coast of Mexico, I venture to offer a few remarks concerning local conditions that govern the practical part of such undertakings. Many of the oil companies lately formed show a glaring disregard of the fundamentals essential to success.

The oil business in Mexico is practically a new thing to the British public as it is also to the majority of mining engineers. As the selection of the land to be exploited is perhaps the first practical move made by the budding company, let me point out the more prominent features that go to make a desirable tract of oil land. To begin, the property should be either near to a port or to a navigable river, and should have an abundant supply of fresh water at hand for drilling purposes and for use in the boilers. The supply of firewood also must be ample and cheap.

These necessities being at hand, the position of the selected land relative to the main anticlines or oil pools of the district must be studied. It is not sufficient to know that the property "occupies the centre of the oilfield" or that such and such a productive well "is only a few miles distant." The expert reporting on any oil property should state clearly the nature of the physical features upon which his opinions are based. The general direction and extent of the longer axis of each important anticline, as also the dip and lateral extent of each leg of it should be clearly stated. If the log of any oil-well in the district can be obtained, a copy of it should be contained in the report, together with a condensed description of the geology of the particular locality under consideration, being careful to give information respecting the existence and distribution of any igneous rocks that bound or otherwise affect the oil-bearing strata.

In districts where petroleum is found only along the anticlines, it is of course hopeless to look for oil in the synclines, and conversely. If the land selected is on a leg of an anticline, the next question is whether the oil could be reached by means of drilling. In cases where the leg has a sharp dip, a well sunk at a point some miles to one side of the major axis of the anticline of which it forms a part, would fail to find any oil simply because the petroliferous stratum lay too deep to be reached by the present system of drilling.

In cases where oil occurs in irregular pools in horizontal or gently inclined strata, it often happens that a well drilled close to another that is producing largely, will fail to show any oil whatever. The reason for this is that the degree of porosity in a rock rarely remains the same throughout its whole extent. Thus it may easily be understood that the porous or spongelike areas of a certain stratum may, under favourable conditions, collect or store petroleum in large quantities. Other portions of the same stratum may be quite dense and barren of oil owing to the fact that any pores formerly existing have been filled with lime or some other substance during an epoch prior to the formation of the oil.

Supposing the physical and geological features of an oil property to be favourable, there still remains as an open question the quantity of oil which it is capable of producing. Only actual drilling will settle this.

Under favourable conditions a well producing only a moderate number of barrels of oil daily, will pay. On the other hand, a very productive well situated at a point distant many leagues from navigation and in a mountainous country, may belong to the 'white elephant' class. The conveyance of petroleum by means of long pipe-lines is always an expensive item, but in cases where the oil to be piped is of the heavy kind generally found on the Mexican Gulf coast, it is not possible to pipe it for any great distance except at a prohibitive cost. The thick heavy asphaltic petroleums cannot usually be pumped for more than 40 miles in one stage. Pipe for use in a pipeline costs about $900 (U.S. currency) per mile at the factory. The estimated weight of 4 in. pipe is 9500 lb. per mile. The laying and painting costs about 10 cents per linear foot.

Before undertaking the purchase of a drilling plant for any particular property, it is necessary to know something definite regarding the kind of rock to be drilled. Hard rocks necessitate the employment of one kind of machinery, and the softer ones, such as marl, quite a distinct type. In drilling the hard rocks found at some points in the Mexican oil region, the Californian arrangement with a 'calf wheel'

is generally employed. The 'calf wheel' attachment is very necessary, as long strings of heavy casing have often to be handled. It is also generally important that the casing be kept moving when drilling caving ground, to prevent it sticking. When drilling the softer rocks, such as the blue marl found over large areas of the Gulf oilfields in the States of Vera Cruz, San Luis Potosi, and Tamaulipas, the rotary system of drilling is successfully employed.

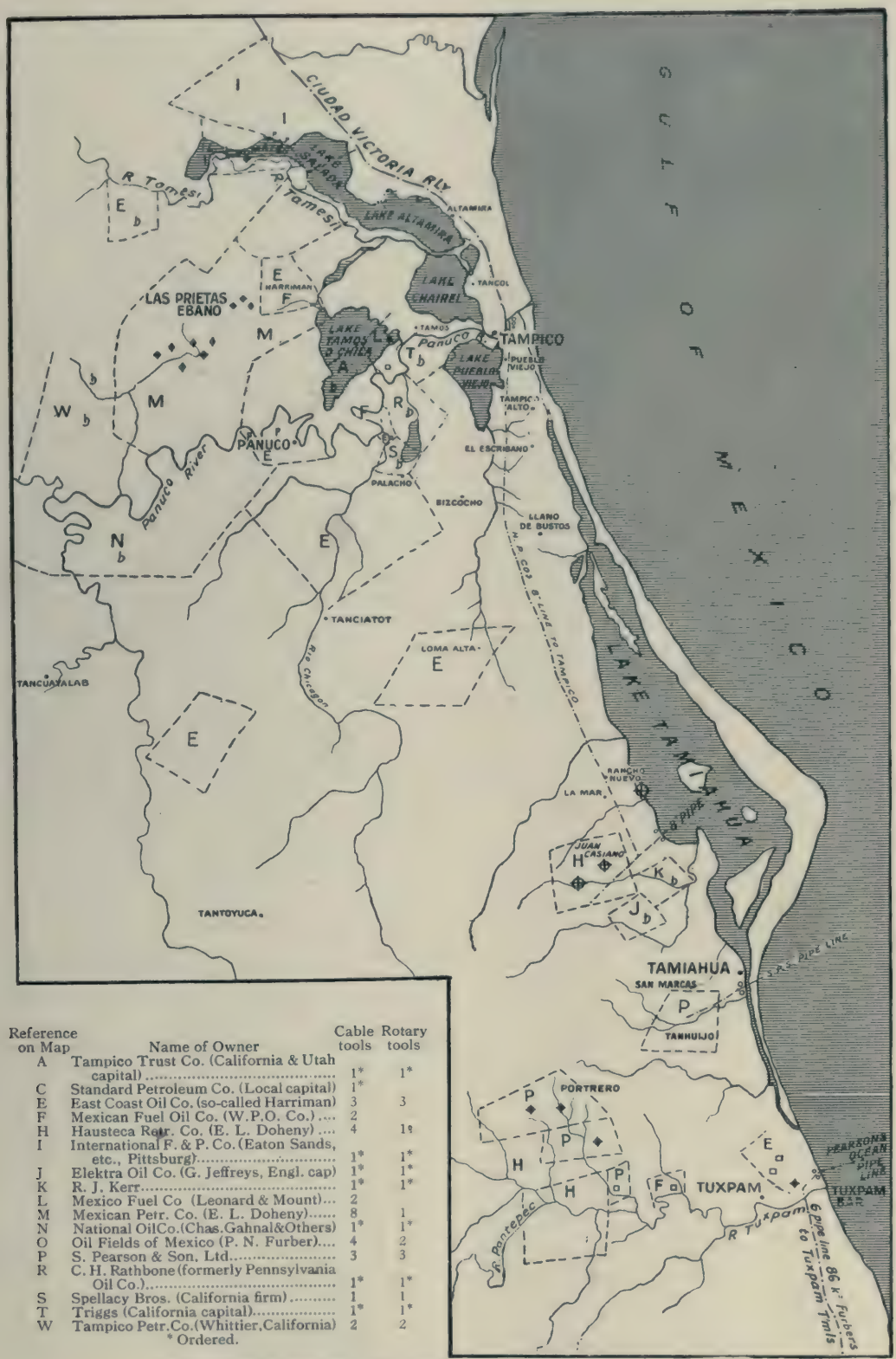
In soft or loose ground the hydraulic rotary process of drilling is the only one suitable. If the proposed well is likely to be deep, a rig of the heaviest and most powerful type should be used. The Southern Wells Works of Texas manufactures a hydraulic rotary machine which has given most satisfactory results in drilling the marls and shales found in Mexico. One well in the Tuxpam district was drilled to a

STREET SCENE IN MEXICO.

The type of machinery selected must be suited to local requirements. If this is neglected, serious loss of time and money may result, a point never better shown in a practical way than at the time two drilling 'rigs' were put to work on some oil-lands near Tuxpam, in Vera Cruz, and reported to be the property of the late E. H. Harriman. On this property, both the Standard cable system and rotary hydraulic plants were erected. The property showed hard sandstone at the surface, which was subsequently proved to be underlain by soft marls and shales. The Standard or cable rig drilled 500 ft. in three months, while the rotary hydraulic (Parker) machine made 1500 ft. of finished hole in the same space of time. At the start the cable rig gained in footage, but as soon as the sandstone was passed and drilling in marl began, the cable rig became practically helpless.

depth of 4000 ft. with a Parker rotary rig. But all types of the so-called 'portable' rigs should be carefully avoided if it is proposed to drill to any depth beyond, say, 800 ft. Beyond this depth they cannot handle the casing.

Before actual drilling is commenced, the services of good drill-men should be secured. Unfortunately it is generally believed that the drilling of deep wells is an easy matter, which can be successfully undertaken by any ordinary mechanic. The reverse is more nearly true. The drilling of a deep well is a serious undertaking, and it requires a degree of skill that can only be acquired from many years of experience. A joint of casing or drill pipe badly put together or the faulty setting of a string of casing may be the cause of losing a well that has cost a small fortune.



Reference on Map	Name of Owner	Cable tools	Rotary tools
A	Tampico Trust Co. (California & Utah capital)	1*	1*
C	Standard Petroleum Co. (Local capital)	1*	
E	East Coast Oil Co. (so-called Harriman)	3	3
F	Mexican Fuel Oil Co. (W.P.O. Co.)	2	
H	Hausteca Petr. Co. (E. L. Doheny)	4	1?
I	International F. & P. Co. (Eaton Sands, etc., Pittsburg)	1*	1*
J	Elektra Oil Co. (G. Jeffreys, Engl. cap)	1*	1*
K	R. J. Kerr	1*	1*
L	Mexico Fuel Co (Leonard & Mount)	2	
M	Mexican Petr. Co. (E. L. Doheny)	8	1
N	National OilCo. (Chas. Gahnal&Others)	1*	1*
O	Oil Fields of Mexico (P. N. Furber)	4	2
P	S. Pearson & Son, Ltd.	3	3
R	C. H. Rathbone (formerly Pennsylvania Oil Co.)	1*	1*
S	Spellacy Bros. (California firm)	1	1
T	Triggs (California capital)	1*	1*
W	Tampico Petr. Co. (Whittier, California)	2	2

* Ordered.

MAP OF THE MEXICAN OIL REGION. FROM NOTES BY H. S. DENNY.

The manager in control of the drill-men should be one who has had practical experience in drilling for oil. It is not sufficient that he possess good administrative ability; he should be a man who is able to guide the driller in his duty as also quickly to correct any slovenly work or incompetence.

When purchasing a drilling plant for any particular locality, it must be borne in mind that the deeper the well to be bored, the greater the horse-power of the engine required. The other parts of the machinery, of course, must be heavy and strong in proportion. A rotary rig suitable for drilling to a depth of 3500 ft. in marl or shale can be purchased at a cost of about $13,500 at an American factory. The price given includes the purchase of the necessary strings of 10 in., 8 in., 6 in., and 4 in. casing, drill-pipe, all small tools, some 'fishing' tools, two large Parker pumps, and a good supply of small parts. The weight of such a rig would be about 254,000 lb., including the casing. The freight from the United States to the Vera Cruz oilfield, together with the import duty imposed by the Mexican government, would amount to about 60% of the first cost.

The actual running expenses, using one rig and working one shift per day, would be:

	Per month
1 Drill-man	$150
1 Helper	125
2 Mexican labourers	40
2 Teamsters (Mexicans)	30
1 Chinese cook	25
1 Boy	10
2 General labourers	15
Total	$395

The general expenses per month when working on the above scale would include $225 for 150 cords of firewood, $150 for the board of six men, $100 for pasturage, lubricants, office expenses, repairs, etc., making a total of $475. The total running expenses would amount to $870 per month, to which must be added the salary of the local manager.

Mexican oil varies. The heaviest varieties are found at Ebano, San Luis Potosi, and the lightest yet discovered are found in the Furber district of Vera Cruz. The new wells in the neighbourhood of Tuxpam, on the Tanhuijo and Potrero del Llano leases, are also producing fairly light oils. In comparing the oils from different districts, while the specific gravity is about the same, the viscosity varies. This is an important point to be considered if a pipe-line is to be constructed, for the more viscous an oil is, the greater will be the difficulty in pumping it through a pipe-line.

The development of the oil industry in Mexico has perhaps reached its maximum as regards the production of petroleum destined for distillation and subsequent use in the form of illuminating oil and gasolene. The industry is already in the hands of two powerful companies—the Pearson or Aguila company, and the Waters-Pierce—and it is safe to say that the field is held by these two against all new comers.

The future of any new oil company in Mexico lies in its ability to produce a cheap fuel-oil. For this the demand in Mexico is at present unlimited. It could be consumed economically—as compared to solid fuel—by a vast number of mining and other industrial companies as well as the railways and factories. When comparing liquid fuel in the form of petroleum with such solid fuels as coal and coke, the advantages of the liquid over the solid forms are enormous. To mention only a few of them it may be said that fuel-oil can be sold much cheaper than coal, costs less to handle, produces no smoke, clinker, or ash, is practically self-stoking and produces more steam, weight for weight, than does coal. Oil usually gives a larger overload capacity than coal and is therefore excellent for an emergency.

In attempting to secure such land from a Mexican it is necessary that the person who enters into direct negotiation with him, should not be only conversant with local conditions, but should also speak the language well. To send out the newly fledged mining graduate to secure property in Mexico, or to engage a person whose knowledge of the Spanish language may be compared in its lucidness to the English expressions of the average Chinese cook, is both useless and costly. English is not spoken in Mexico except by a few people in the larger towns. When travelling in districts removed from the railways and big towns, both food and bedding must be carried. The ordinary Mexican Indian and even the poorer class of *hacendado* possesses but a meagre idea of what we call the barest necessities of life.

Travelling in a Pullman car or the view of the country obtained under the circumstances enjoyed by the average tourist or sightseer gives only a misleading idea of the real Mexico. Those who know the innermost depths of the Mexican and his ways and thoughts are those who have gone far from the tourist routes, and who have lived on dirty *tortillas* and *frijoles* for weeks at a time. On the other hand, the Mexican is nothing if not polite and diplomatic, and the visitor to his country may generally be recommended to adopt these virtues also.

PROSPECTING FOR TIN IN SIAM

By G. B. ADENEY

THE methods of prospecting Siamese tin-gravels deserve some record, and I hope that the following notes will prove of value to others who may go to that district. I will first describe the indications which lead the prospector, then I will deal with the methods employed in proving the value of the ground, and finally give some idea of the results obtained.

Indications are numerous, such as native workings (generally Chinese) often abandoned, the presence of tin in streams or in surface soil, and native information. Sometimes it happens that Chinamen are working a small rich piece of ground in a large area of lower grade material suitable for dredging or hydraulicking, or the natives are found washing shallow surface deposits close under the hills, leaving areas of 'karang' or tin-bearing gravel further down in the flats. The Chinese often have to abandon open-cast mines because of an excess of water or of constantly falling sides; such ground might be profitably dredged. It may be that mines are worked down to the sea and even pushed out into the tidal waters by means of embankments, as at Tongkah harbour, but the day comes when the expense becomes too much and the mines are shut down.

Native hill-workings are generally in soft decomposed kaolinized granite known locally as 'kra.' It is probable that the drainage from these soft tin-bearing hills has produced a deposit of gravel somewhere in the adjacent valleys or plains; boring will show the extent and value of such deposits. The presence of tin in streams and in the surface soil leads the prospector to look for the source of enrichment; but it is a general rule that where tin is found in the surface soil, there will be no gravel directly beneath. This was found to be so, clearly, at one place where I was boring. The land was an extensive open plain. Our attention had been drawn by small native hydraulic mines at the foot of the hills, and by shallow surface workings two or three feet deep. Boring proved that most of this was plain overlay tin gravel, but the surface workings generally covered barren islands. I say 'islands,' for boring showed that the bedrock, decomposed slate, rose to within 5 to 25 ft. of the surface. I believe that these islands were formerly slate hillocks threaded by stanniferous veins and that during denudation they contributed to the enrichment of the gravel.

It is easily imagined that gradual denudation also caused the heavy mineral to be concentrated, forming superficial deposits. Bore-holes at the edge of these hillocks frequently proved the gravel to contain coarse ore, not water-worn, showing that it was of local derivation.

Obviously, pits are more satisfactory than bores, for in the former the prospector can examine the nature of the overburden, and take samples; besides, pits are open for further examination by a consulting engineer. We never found it possible however to pit a true alluvial deposit, for the gravel will always be the drainage stratum above an impervious bedrock. In

the driest of dry seasons the gravel may be reached, but rarely the bedrock, and it is never possible to take a fair sample. In one or two cases we were able to sink pits at the foot of hills, though the land was more in the nature of 'drift' than a true alluvial deposit.

In boring we used tools similar to the Banka type of drill, but we had the sets made to suit our own requirements. We used both 4 in. and 5 in. external piping and found the 4 in. the better, for they were easier to keep well down. Generally the overburden consisted of sandy clays or alternations of clay and sand. Most of the boring was done by an ordinary clack-valve sand-pump; some stiffer clays had to be bored by the auger bit. Chisels were only used to break a stone or to test a solid bedrock.

We employed Chinese labour, which is excellent. The Hylam coolies seem to like the work. It was not unusual to bore over 60 ft. in a day, clean-up, and move to the next position. With 7 coolies, 1 headman, and a cook, the cost in wages was $6·10 (Straits currency, $1 = 2s. 4d.) per day, or say, 3d. per foot. I should say that the average labour cost was under 6d. per foot. We could sink pits for about 7d. per foot.

In commencing to prospect a new area we would generally aim to bore a line of holes across the probable run of gravel; these holes might be 130 yards apart. If there was any probability of a run of gravel a further line of bores, say a quarter to half a mile from the first, would be sunk. Other such lines of holes can be bored so as to mark the run and then if sufficiently promising the area can be marked in squares and thoroughly bored. If the deposit appeared to have no definite run we bored in squares; later, if the ground showed sufficient promise, check holes were put in the centre of these squares. The number of holes per area depends on the uniformity of the results; generally 1 hole per 1½ acres should be ample to test a property.

A careful superintendent can make notes on the nature of the overburden that will help to decide the best method of working the land, and further examination of the overburden can easily be effected by means of an occasional pit.

When boring in the gravel itself great care must be taken that the lining-pipes are ahead of the sand-pump, otherwise the gravel may run into the pipe, and too much being obtained, the result will be misleading. By careful watching, even in a loose and sandy gravel, the superintendent will know if he has too much and can make a suitable correction. We generally found, however, that we got too little gravel. Again it is impossible to clean out the hole perfectly, and some heavy tin ore is generally left behind. This can be seen when, on drawing the pipes, the bottom one is occasionally found to be plugged by a core of soft bedrock; if this pipe be inverted into a tub and rinsed, at least 10% more tin ore will be collected for the sample.

I hold that in a medium clayish gravel a careful superintendent will always get too small a quantity of ore, and this has been borne out by both the Tongkah Harbour Tin Dredging Co. and by the Renong Tin Dredging Co., for both these companies are actually recovering more tin than the bore-holes had shown the ground to contain.

When commencing work on new land it is necessary to examine the overburden carefully, but it may be found that all the ore occurs in the gravel, which lies on the bedrock and varies in thickness from 7 to 10 ft. or more. All the gravel obtained is put into tubs. We always stood our tubs on canvas sheets 5 ft. square to save the droppings when emptying the sand-pump. It is best not to quite fill the tubs so that if the gravel is sticky it can be puddled in the tubs by hand before being panned. Native wooden pans called 'dulongs' were used. The loss when panning should be negligible.

By means of the 'dulong' and one or two cocoa-nut shells the sample can be cleaned to 90% tin oxide. This should be dried, and cleaned of iron chips abraded from the sand-pump, etc., by small magnets, and finally carefully dry-vanned and weighed.

Besides describing the thickness and nature of the overburden we described our ore samples as coarse, medium, or fine, as the case might be. It is most convenient to express the final yield of the land in pounds of tin oxide per cubic yard over all, that is, from surface to bedrock.

By means of a platform on two native boats, we tested bays and rivers. The pipes are lowered through a well in the pontoon, between the two boats. Care must necessarily be taken that the pontoon is secured from turning or swinging, else the pipes will be broken and probably lost. We used heavy anchors and long stakes. The most uncomfortable spot for boring is a mangrove swamp, where the mud is deep and offensive, the ground made irregular by high crab heaps, and awkward by tree roots, where the mosquitoes swarm and the air seems stagnant, where the loathsome crocodile lurks looking exactly like the trunk of a fallen mangrove tree.

COMPANY REPORTS

El Oro Mining & Railway.—This company was floated by the Exploration Company in 1899 to acquire the El Oro gold mine near Mexico from an American company of similar name. The purchase price was £820,084 in cash and £65,988 in shares. No less than £404,661 has been provided out of revenue for the building of metallurgical plant and for other purposes. The company floated the Mexico Mines of El Oro to acquire a property near to, on the other side of the Esperanza mine, and the Somera Gold Mining company to acquire property on the western side. The latter was re-absorbed in 1908 in order to obviate disputes as to the ownership of certain veins. The issued capital now stands at £1,147,500, and £1,353,312 has been distributed as dividends. The report for the year ended June 30 shows that the recent remodelling of the mill was completed in February. This work involved the provision of 3 new tube-mills and the dismantling of the old 100-stamp mill, so that the work is now done by the No. 2 mill, containing 100 stamps built in 1905, together with 8 tube-mills. With this rearranged plant the stamp-duty has been raised to 10½ tons and the tube-mills give an all-slime product. During the year under review 316,138 tons was crushed and the production was $2,171,774 in gold and $390,931 in silver, a total of $2,562,705, or $8·10 per ton. The amount of ore treated monthly when both mills were working was approximately 25,000 tons; after the reorganization this was raised to 30,000 tons. The costs during the year at the mine were $1,557,889 or $4·93 per ton, and it is noticeable that the new method of treatment reduced the cost from $5·50 to $3·80 per ton. There were other expenses on special ventilation work, cost of London office, and depreciation. There was also a profit on the railway and on the sale of shares in the Mexico Mine. The dividend distributed absorbed £172,125, being at the rate of 15%. The report by A. F. Main, the manager, shows that development work has been prosecuted actively, and that the reserve of ore on June 30 was 441,639 tons, averaging $8·06 in gold and 3 oz. silver per ton, as compared with 383,000 tons, averaging $11·10 in gold and the same in silver a year ago. The average extraction is 94% of the gold and 78% of the silver. It will be seen that the yield is decreasing, as well as the cost of treatment. Progress in the sinking of the new ventilating shaft near the Esperanza boundary has been rapid and it reached the 1000 ft. level in January. The conditions at these deep workings were thereby much improved and the exploitation of the higher grade ore found here is proceeding actively.

Mexico Mines of El Oro.— This company was formed by the Exploration Company in 1904 to acquire the Mexico mine at El Oro, situated to the north of the Esperanza, which separates this mine from the property of the El Oro Mining & Railway Co., particulars of which are given above. The company has a capital of £180,000 and the total dividends to date amount to £283,500. In addition £113,142 has been spent out of profits on plant and development work. The metallurgical equipment consists of 40 stamps, 6 tube-mills, cyanide plant, and concentrators. During the year ended June 30, 136,372 tons of ore was crushed in the stamps. The sulphide ore recovered on the concentrators used to be sold to smelters, and during the year 253 tons worth $49,693 were disposed of in this way. More recently the concentrate has been treated on the spot by cyanide, and 607 tons has yielded bullion worth $60,749. It is found that by cyaniding, the extraction from the concentrate is 97½% of the gold and 91½% of the silver, and the profits are greater than when selling to smelters. The total extraction was $1,026,923 in gold and $365,413 in silver, a total of $1,392,336. The profit and loss account, in English money, shows an income of £294,364 and an expenditure of £139,373, leaving a profit of £154,990. Out of this £7893 has been spent on capital account, £8000 is allowed for depreciation, and £9000 allocated to income tax. The dividend distributed was £126,000 being 14s. per £1 share. A. F. Main, the manager, estimates the reserve on June 30 at 283,735 tons, containing 9·57 dwt. gold and 5·9 oz. silver.

Alaska Treadwell.—This company was formed in San Francisco in 1890 to acquire the Paris mine on Douglas Island, Alaska, which first started work in 1882. Adjoining properties were developed by the same people, and were floated as the Alaska Mexican in 1892, and the Alaska United in 1895. These three properties are under the same control and management, and mining and metallurgical work is often interchanged according to convenience. F. W. Bradley is consulting engineer and a director, and Robert A. Kinzie is superintendent for the three companies. The ore is partly free-milling and some of the gold is also recovered in pyrite by concentration. Until 1899 this concentrate was chlorinated but since then it has been sold to the Tacoma smelter. The metallurgical equipment of the Alaska Treadwell consists of two mills, one containing 240 stamps and operated by water power in summer and steam in winter, and the other containing 300 stamps operated in summer only by water power. The report for the year ended May 31 shows that the yield per ton has been greater during the past year than for the last 13 years. The figure was $2·79, as compared with $2·21 the year before. At the same time the cost of mining and extraction has decreased from $1·54 to $1·22. The cost varies from year to year in a way that may be thought unusual; the variation chiefly depends on climatic conditions and the length of time during the year that the mill can be run by water power. During the past year 744,226 tons went to the stamps; the yield of gold by amalgamation was $1,203,988; 14,046 tons of concentrate produced $875,329; total yield $2,079,318. The working profit was $910,391, out of which $850,000 was distributed as dividend, being at the rate of 17%. The total dividends to date paid by the present company have been $10,685,000, in addition to which $650,000 was distributed by the previous owners prior to 1890. The total gold produced has been worth $26,141,880. During the past year 13,011 ft. of development work was done, chiefly on the 1250 and 1450 ft. levels, and the main shaft has been sunk to the 1750 ft. level. The ore reserve on May 15 was 5,899,364 tons.

Consolidated African Copper Trust.—This company was formed in 1902 to acquire a number of copper properties in various parts of Rhodesia and adjoining countries, belonging to the Consolidated Gold Fields of South Africa, the London and Johannesburg Trust, and other groups. The control was in the hands of the first-named. So far the chief subsidiary flotation has been the Edmundian Copper company, which was formed to acquire the mine of that name over the border in Mozambique territory. The Consolidated African Copper Trust has been in financial difficulties for some time, owing to the development of various properties taking more money than was expected, and owing to difficulties at the Edmundian due chiefly to faulty construction of plant. In order to put the company on a sound basis a scheme of reconstruction has been propounded, and accepted by shareholders, whereby the London and Johannesburg Trust guaran-

tees £75,000 of new capital and acquires the control. By this scheme the shareholders take 558,000 new shares of 5s. each in exchange for a similar number of £1 shares; 300,000 new shares of 5s. each are being offered for subscription and will be absorbed by the guarantors or the shareholders, the subscribers having a call at par on an equal number of shares for two years; 160,000 shares are being issued in satisfaction for loans, and 80,000 are being held in reserve. The loans were advanced for the purpose of developing the Umkondo mine and for keeping the Edmundian company going. The future policy, as outlined by H. A. Piper, is to keep the Edmundian mine in order, and to bring the Umkondo and Alaska properties into a shape suitable for flotation. Mr. Piper though dissatisfied with the Edmundian plant thinks highly of the mine. As regards the Umkondo, which is in the Victoria district, faults and dikes have interfered with development and capital is required for further work. The reserve is estimated at 90,000 tons averaging 8%. The Alaska property contains 300,000 tons of 3% ore and a flotation method of concentration is to be adopted.

Rhodesian Exploration & Development.—This company has been expanded by the consolidation with it of the Rhodesian Banket, Etna Development, Rhodesian Abercorn Shamva, and the Gold Schists of Rhodesia. These four companies belong to the same group and the amalgamation is a matter of directorial policy. At the same time it enables Abe Bailey to take an interest in the group and to guarantee the issue of new shares. The capital of the Rhodesia Exploration & Development has been increased from £450,000 to £2,000,000. Shareholders in Rhodesian Banket Co. will receive 7 new shares for every 10, in the Etna Development 1 for every 2, in the Rhodesian Abercorn Shamva 4 for every 5, and in the Gold Schists 1 for every 2. The new shares allotted to shareholders in the various companies are 288,788, 96,760, 203,034, and 203,350 respectively. No new shares are allotted in respect to the shares in these companies held by the Rhodesian Exploration & Development. It may be noted that the Shamva and Gold Schist companies have only recently been formed, as recorded by us in our March and May issues. The Rhodesia Exploration & Development is a profit-earning company and has large cash assets. The four other companies have also large sums of working capital. Further capital is to be raised by issuing 250,000 new shares at £2. 5s. each, which have been guaranteed by Abe Bailey. The total working capital and realizable resources will be £1,600,000. The scheme has been approved by the shareholders of the various companies.

Penhalonga.—In our August issue we gave an account of the condition of this company, which owns gold properties in the Umtali district of Rhodesia, and is in the control of the Anglo-French-Farrar group. We mentioned that shareholders had not responded to a scheme for reconstruction based on the recommendations of H. A. Piper, the consulting engineer, and C. R. Pinder, the late manager. Another proposition has now been put before shareholders and adopted. This is a drastic reconstruction for both the debenture holders and shareholders. The capital of the new company is £110,000 in shares of £1 each; of these 66,450 go to the debenture holders in the proportion of 1 share for each £3 debenture; £13,750 are allotted to present shareholders at the rate of 1 for every 20 shares in the old company; 27,500 are being offered at 10s. each to present shareholders; and the remaining 2300 will be held in reserve. The issue of 27,500 new shares was guaranteed by some of the leading shareholders, so the success of the scheme was assured. This will provide working capital to the extent of £13,750, and the company has assets sufficient to bring the available funds to £21,000, the amount considered requisite for the further prosecution of development work.

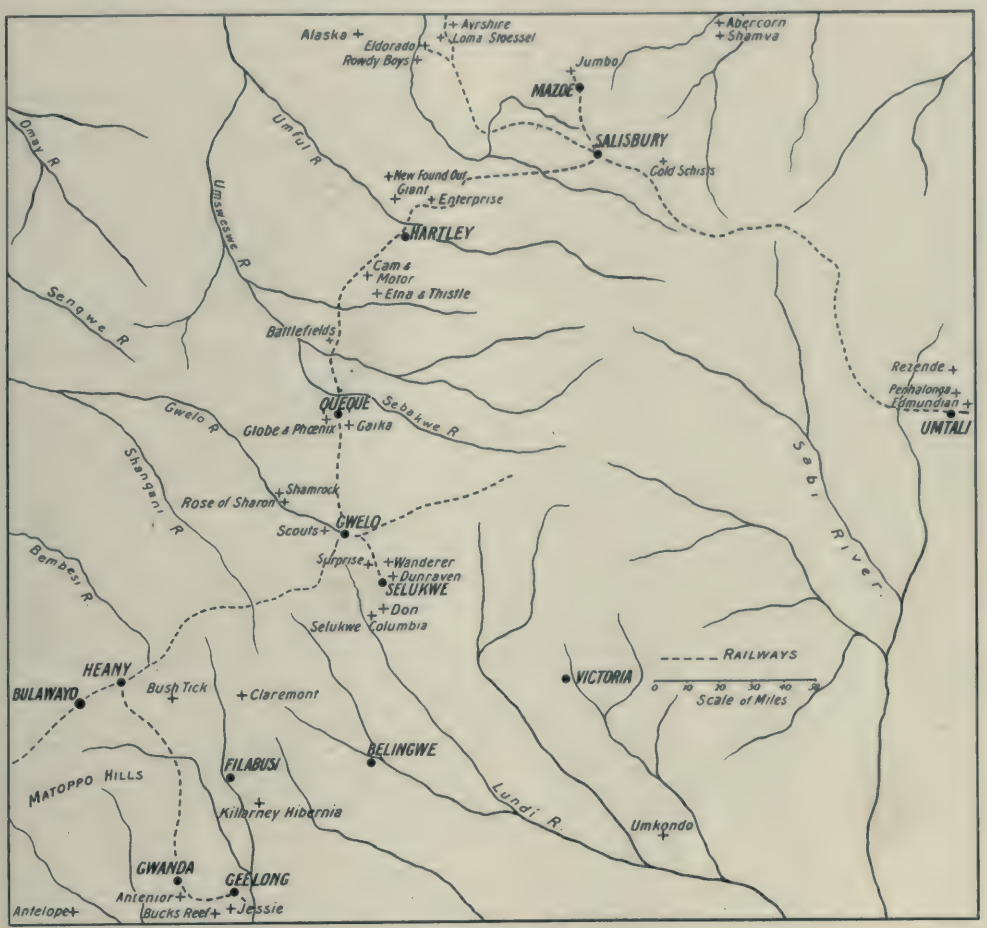
Cam & Motor Gold Mining.—This company has been formed by the London & Rhodesian Mining & Land Co., which is controlled by Julius Weil & Co., for the purpose of acquiring the Cam and Motor gold mines and other claims in the Gatooma district of Southern Rhodesia. Other companies, beside that mentioned above, have interests in the properties. The capital of the company is £500,000, of which £225,000 in shares and £100,000 in cash goes to the vendors; 225,000 shares are being offered to the public at 27s. 6d. each, the whole issue being underwritten by J. G. Bone & Sons, who have a call on the remaining 50,000 shares. The company therefore starts with approximately £200,000 in cash for working capital. The Cam and Motor mines have been examined by V. S. Allen, of the firm of Pearse, Kingston, & Browne. The geological formation consists of crystalline schists traversed by dikes of varying character. The ore is found in connection with silicious impregnations of the rocks and dikes, and arsenic and antimony are found associated with it. The main lode at the Motor has been proved by two levels, No. 1 being in ore for 685 ft. and No. 2, 280 ft., the average width of the lode being from 4 to 6 ft. and the content 7 dwt. In the main lode at the Cam, four levels have been started, and the width is 5 to 6 ft. averaging 14 dwt. At both mines additional lenses and shoots of ore are found, and the orebodies generally are difficult to estimate for both width and content. Mr. Allen figures that 222,000 tons are exposed in the Motor, averaging 10½ dwt., and 80,000 tons in the Cam, averaging 11½ dwt. He recommends development on a large scale and the provision of extensive plant, mentioning £150,000 as a suitable sum for the purpose.

Bechuanaland Copper.—This company was formed in May 1909 by the Bechuanaland Exploration Co. to acquire the license to work the Bushman, Santoy, Nondu, Kelly-Kenny, and Outlaw claims, 120 miles southwest of Bulawayo. The license is held from the British South Africa Co. which takes 50% of the profits. The capital of the company is £135,000 in 270,000 shares of 10s. each. The purchase price was £10,000 in cash and 30,000 shares; 120,000 shares were offered to the public, but were underwritten partly by the promoters and partly by L. Hirsch & Co., whose consideration was a call at par on the remaining 120,000 shares. The report for the first year, ended May 31, shows that the properties are situated on old workings and that operations have been confined so far to the Bushman. The development work was laid out by S C. Dyer, and afterwards let on contract. E. Jorissen is the consulting engineer. During the year, 2382 ft. of work was done on 8 shafts and 4 levels. Mr. Jorissen shows that the sulphides have been distributed throughout dolomite and quartzite by means of veins of pegmatite and that the ore is found in lenses. In many places galena has replaced the copper sulphides; calcite, graphite, and oxides and carbonates of copper are also found. He reports that the copper content varies, and is of opinion that, while the conditions are generally promising, much more prospecting and development work will be required before the economic value of the deposit can be ascertained. As regards the graphite, this is found to exist in large enough amounts to give it a commercial value.

Don Proprietary Mines.—This company was successfully floated in August, without the issue of a pro-

spectus, for the purpose of acquiring the Don, Peggy, and Scouts mines in Rhodesia. The company is registered under local laws and has an office in London. Clement Dixon is consulting engineer and Thomas J. Gibb is on the London board. The Don mine is 8 miles south of Selukwe, Scouts is at Gwelo, and Peggy is further to the southwest near the Claremont and Nelly mines. At the Don mine, the vein has been traced for 1000 ft. on the surface and a shaft has proved the vein to average 32 dwt. over 22 in. Stoping operations are done at a width of 36 in., and the average content of the ore mined is thus reduced to 19 dwt. A development. The nominal capital of the company is £75,000, and of this £20,000 is represented by cash available as working capital; as two of the mines are equipped with reduction and extraction plant the prospects of the company appear to be favourable and promising.

Salisbury Gold Mining.—This company was formed under Natal laws in 1886 to acquire a small property on the outcrop in the central part of the Rand. The mine is worked conjointly with its neighbour the Jubilee and the two are surrounded by the Ferreira, City & Suburban, and the Village Main Reef. Milling



SOUTHERN RHODESIA.

10-stamp mill and cyanide plant were erected at the beginning of the year and crushing started in May. During July 1200 tons was treated, and the recovery was worth £2600 or 43s. 4d. per ton. The cost of mining and milling was approximately £1000 or 16s. 8d. per ton leaving a profit of 26s. 8d. per ton. Mr. Dixon advises that work should be centred on further developments and that in the meantime the mill should only run half time. Less development has been done at the Peggy mine, but the indications are highly favourable and a battery consisting of 7 stamps together with cyanide plant has been erected. The 'probable' ore here is 8500 tons averaging 12½ dwt. over 31 in. The Scouts property has not been fully proved, but surface indications are excellent and warrant vigorous

commenced in 1887 and the company now owns 60 of the 100 stamps of the joint battery. The report for the year ended June 30 shows that 95,057 tons was crushed in the mill, and 14,348 oz. recovered by amalgamation, being at the rate of 3 dwt. per ton. The cyanide plant treated 60,499 tons of sand producing 6463 oz. or 2 dwt. per ton, and 30,215 tons of slime producing 1419 oz. or 0·9 dwt. per ton. Dump ore yielded 411 oz. and cyanide slags 36 oz. The total production was 22,678 oz. or 4·77 dwt. per ton. The income was £96,917 or 20s. 4d. per ton and the expenditure at the mine was £72,074 or 15s. 2d. per ton, leaving a profit of £24,843 or 5s. 2d. per ton. Dividends amounting to £25,000 have been distributed being at the rate of 25% on the capital. Mr. Carr esti-

mates that the ore reserve on June 30, after allowing for removal of waste at surface, was 162,289 tons, in addition to 84,909 tons of ore of doubtful profitableness. Judging by the extent of the property the life of the mine may be estimated at 5 years. In 1909, three-eighths interest was bought in the Claremont gold mine in Rhodesia, in partnership with the Jubilee company, and subsequently an interest was acquired in the adjoining Nelly Extra. A 10-stamp battery and a chilean mill have been erected. For the purpose of acquiring these interests 35,000 new shares were issued in May. The management of these Rhodesian mines is in the hands of T. W. B. Wayne, and the report states that the developments are satisfactory.

Tinfields of Northern Nigeria.—This company has been formed by the Champion Gold Reefs of West Africa for the purpose of acquiring two tin-gravel properties in Northern Nigeria. One of these is the Federri and is 8 miles in extent; 300 acres has been proved to contain a gravel deposit from 2½ to 3½ yd. deep and averaging from 3 to 6 lb. of cassiterite per cu. yd. It is intended to erect plant to produce 300 tons of cassiterite per year and the cost of working is estimated at £42 per ton. The second property is the Dila River or Doss, which consists of 9 miles of country with a proved area of 400 acres, 3 to 5 yards deep and averaging 3 lb. per cu. yd. The output is calculated at 500 tons per year at a cost of £40 per ton. L. H. L. Huddart is consulting engineer and C. G. Lush is on the board. The capital of the company is £100,000 of which £70,000 in shares goes as purchase price and £25,000 has been subscribed as working capital. At the above-mentioned rates of working, the proved areas are expected to last 26 and 23 years respectively.

Anchor Tin Mine.—This company was formed in 1895 to acquire a property at Lottah, in the northeast of Tasmania. The property is a stockwork in granite and the tin content is very small. The efficiency of operation is high, but the profit has never been great enough to provide a dividend. The company was reconstructed in 1902 and 1909. Bedford McNeill is consulting engineer and James B. Lewis is manager. At the last reconstruction the issued capital was reduced to £25,159 in ordinary shares and £6540 in preference shares, and there are £25,000 of 4% debentures. The report now issued covers the period of 14 months from the reconstruction in February 1909 to March 31. During this time the work at the mine and mill has been suspended twice on account of drought, which Mr. Lewis says has been the most severe in his experience. Consequently the output has been smaller and the cost higher than usual. The ore treated in the 100-stamp mill was 102,283 tons, not much more than half the usual amount, and the average number of stamps running was 66. The black-tin concentrate recovered was 158 tons. This is 3½ lb. of black tin or 2½ lb. metallic tin per ton. The concentrate is smelted at Mount Bischoff, and the revenue from the sale during the year was £15,743, less £578 smelting charges. The total cost in Tasmania and London was £17,854, and after adjusting accounts for stock of tin in hand at the beginning and end of the period, the result of the year's work was a loss of £1866. Another unfavourable event was a bush fire which destroyed some of the woodwork at the mine and mill. Seeing that the circumstances connected with the drought have been so much against the success of operations, the debenture holders have agreed to wait for their interest and the directors for their fees. An agreement has been made with the Tasmanian Government, whereby £5000 has been borrowed from public funds for five years, for the erection of an aerial cableway. This is now being constructed. The directors also report that additional leases have been acquired.

Avino Mines.—This company was originally formed in 1899 by F. L. Gardner to acquire a mine at Avino, Durango, Mexico, and it has been reconstructed in 1903 and 1909. The ore is complex containing copper, lead, gold, and silver, and many mining engineers and metallurgists have without success attempted to devise suitable methods of mining and concentration. In fact, large sums of money have been spent on plant that has failed to work satisfactorily. The ore deposit is erratic and is difficult to follow and estimate. Among the engineers who have attempted the solution of the problem are A. A. Blow and Ralph Nichols. On the reconstruction in March 1909, R. H. Jeffrey was appointed manager and Edward Hooper was elected to the board. A method of treatment of the ore devised by Henry E. Wood of Denver was adopted on trial, and is still the subject of experiment. The report for the period from the reconstruction to June 30 shows that the ore mined was sorted by hand and the best parts sold to smelters; 43,350 tons was mined, 18,094 tons shipped, 6420 reserved for further treatment, and 17,937 tons rejected as waste. The ore shipped contained 993 oz. gold, 261,000 oz. silver, and 413 metric tons of copper. The total value was £49,023, and the cost of treatment and freight was £28,172. The mining cost was £13,457, and other costs £6300. The net profit in the year's operations was £1115. The issued capital of the company is £56,440, divided into 978,429 ordinary shares of 1s. each and 300,750 priority shares of equal denomination but on which only 6d. is paid up. Mr. Jeffrey reports that considerable improvements have been made, so as to put the workings in good order. The reserve blocked out on June 30 was 57,525 tons and of partly developed ore 33,560 tons. In addition 16,400 tons is at surface awaiting treatment. The average content of the ore is estimated at ½ dwt. gold, 10 oz. silver, and 1¾% copper. The future of the company depends on the system of concentration and extraction now being tested. Details of the process and its results will be available before long.

Consolidated Gold Fields of New Zealand.—This company was formed in 1896 to acquire properties in the Reefton district of New Zealand from David Ziman. The chief mine operated by the company is the Wealth of Nations; the Progress and the Blackwater mines were floated as separate companies and details are given in succeeding paragraphs. Ernest W. Spencer is general manager for the group of mines but he will be resigning shortly. The report for the year 1909 now to hand shows that during the year 15,577 tons of ore yielded bullion worth £22,481 by amalgamation, and the cyanide plant treated 9590 tons and produced bullion worth £5877. The total yield was £28,358 or 36s. 5d. per ton, and the cost was £12,408 or 15s. 11d. per ton, leaving a profit of £15,950 or 20s. 6d. per ton. The reserve on December 30 was estimated at 36,000 tons but Mr. Spencer points out that the ore is difficult to measure. During the year a tube-mill was erected, but the accessory slime-plant was not completed until after the close of the year. The company also owns the Golden Fleece and Humphrey's Gulley mines which are let to tributors, and £2916 was received from this source during the year. In addition £14,000 was received as dividends from the subsidiary companies. The net profit for the year was £29,607 out of which £4004 has been written off for depreciation, and £12,118 has been distributed as dividend being at the rate of 5%. Since the close of the year two other dividends of 5% each have been paid.

The Wealth of Nations is a small mine and it is advantageously worked, but it is not quite big enough for the capital £242,377. The directors call attention to the fact that the founder's share will soon be drawing one quarter of the profits; according to the articles of association the founder takes 25% of the profits after 100% has been paid on the ordinary shares. So far 82½% has been paid in cash and 10% in shares in the Progress mine, and the directors are in favour of exchanging the founder's share for 80,000 ordinary shares. During the year, L. Ehrlich has been elected a director, and E. T. McCarthy is acting as David Ziman's alternate on the board during his absence in New Zealand.

£17,610 was carried forward. The ore reserve on December 31 was 69,000 tons; owing to the irregularity in the width of the vein it is not easy to make an estimate of the reserve. The country rock also causes difficulty owing to its friable nature. The tube-mill started work in August 1909 and the slime-plant was completed later. The latter has not got to work owing to lack of power, and a gas plant is being provided, to make up for the deficiency of the water-power on which the mine depended.

Progress Mines.—This company is a subsidiary of the Consolidated Gold Fields of New Zealand and was floated in 1896. During the last few years the developments have not been sufficient to keep the mill, in

THE BLACKWATER MILL.

Blackwater Mines.—This company is fulfilling the promise made on flotation in 1906 and the developments and the results of metallurgical work are gratifying. Milling commenced in August 1908. During the year 1909, the ore sent to the mill was 29,955 tons and gold worth £66,712 was recovered by amalgamation; the cyanide plant treated 19,635 tons and produced gold worth £6569. The total yield was worth £73,281 or 48s. 11d. per ton, an increase of 10s. per ton over the figures contained in the report for 1908. The cost at the mine was £25,221 or 16s. 10d. per ton, leaving a profit of £48,060 or 32s. 1d. per ton. Out of this London expenses and rates and taxes were paid and depreciation and development were allowed for, and the net divisible profit was £36,853, and, after deducting £6744, the adverse balance a year ago, £30,109 remained to the credit of profit and loss. The dividend absorbed £12,498 being at the rate of 5%, and which there are 65 stamps, fully employed. The report for 1909 shows that the battery treated 35,414 tons producing gold bullion worth £42,978, and the cyanide plant treated 25,025 tons of sand with a recovery of bullion valued at £9052. The total receipts were £52,030 or 29s. 5d. per ton, and the working cost was £46,423 or 26s. 3d. per ton, leaving a profit of £5606 or 3s. 3d. per ton. Other expenses were administration £4977, taxes £2394, depreciation £4331, and expenditure on development £4572. On the other side of the account are dividends on Blackwater shares £4346, and items of interest and profits on the sale of shares, and the final result of the year's operations was a loss of £1894. The year commenced with a balance in hand of £28,141, and a dividend of 5% absorbing £13,750 has been paid and £12,496 carried forward. The report of the manager E. W. Spencer shows that the smelter for the treatment of concentrate, slime,

and accumulated residues was completed towards the close of the year. This material contains a good deal of arsenic and antimony and requires careful roasting.

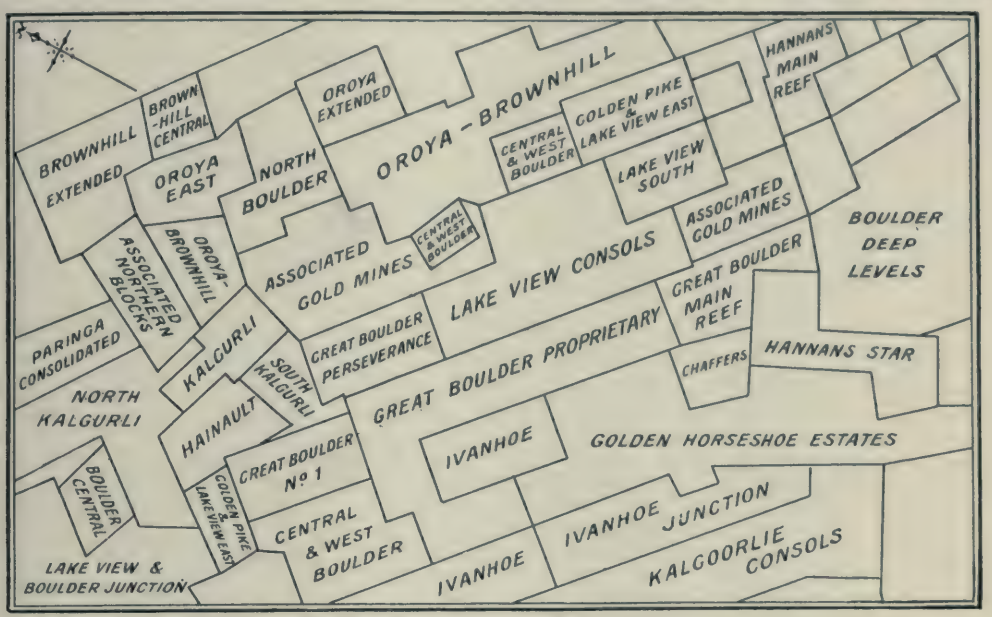
North Broken Hill.—The position of this company is in every way satisfactory; not only are the developments in the mine excellent, but the new concentrating plant is a great success. The report for the half-year ended June 30 shows that the third and final unit of the concentrating plant was put in commission and the amount of ore treated per week has been raised from 4000 to 5200 tons. The total ore sent to the mill was 108,943 tons, assaying 15·4% lead, 6·4 oz. silver, and 12·9% zinc. The production by jigs and tables was 17,912 tons of lead concentrate averaging 70½% lead, 20½ oz. silver, and 6·6% zinc. In addition 53,688 tons of zinc tailing was produced, averaging 17% zinc, 3·6 oz. silver, and 3·9% lead; these were sold to the Amalgamated Zinc (De Bavay's) company. A small plant has been erected for the experimental treatment of the slime, of which 11,568 tons was produced during the half-year, assaying 12½% lead, 15½% zinc, and 7·8 oz. silver. The working cost at the mine has been 9s. 4d. per ton, at the mill 3s. 1d., and development 1s. 5d., a total of 13s. 10d. The total cost was £77,714 and the receipts from the sale of concentrate and tailing was £124,688, leaving a balance of £46,974, as compared with £33,899 the previous half-year. Out of this profit, £2426 was paid for office expenses and taxes, and £17,783 was allowed for depreciation. The dividends absorbed £28,000 being at the rate of 16% for the half-year. The details given by the manager, George Weir, relating to recent developments in the mine are of unusual interest. Owing to an alteration in the pitch, the southern orebody has been found on the 1100 ft. level at a distance further away from the boundary than was expected, and consequently more ore is in this level than on the one above. Not only so but the content of the ore is higher than the average. The company did not suffer at all from the results of the recent coal strike.

Broken Hill South Silver.—This company has suffered during the first half of 1910 from the coal strike and during the greater part of January and February operations were at a standstill. Nevertheless the results for the half-year have been good. It will be remembered that a new concentrator was completed at the beginning of 1909, but did not start work immediately owing to the difficulty of securing suitable terms for the sale of concentrate. Later in the year contracts were settled and the mill was fully employed by the middle of the year. The report for the half-year January to June 1910 shows that during the active four months 132,757 tons was mined and delivered to the mill, assaying 15·2% lead, 12·8% zinc, and 6·4 oz. silver. The weekly rate was 6987 tons as compared with 6424 tons the previous half-year, and the metal content shows an increase of ½% in the lead and zinc and ½ oz. in the silver. The concentrator produced 20,735 tons of lead concentrate averaging 72% lead, 21½ oz. silver, and 5·3% zinc. The zinc tailing produced was 58,915 tons assaying 18½% zinc, 4·2% lead, and 3·7 oz. silver. Some of this tailing went to the Zinc Corporation, but since March the whole output has gone to the De Bavay company. The Zinc Corporation still treats the old dump material of which there are over one million tons on hand. The De Bavay Co. also owns 143,000 tons of old dumps. In addition 215,809 tons of slime have accumulated, averaging 12% lead, 15% zinc, and 6 oz. silver, to be treated when a suitable process is available. The system of filling old stopes with quartz tailing has been extended, and additional filling is now being provided from a quarry. Developments at the mine are most encouraging and in the new level at 1070 ft. the orebody is as valuable as in any part hitherto opened. The cost of mining during the half-year has been 10s. 2d. per ton, development 1s., filling stopes 1s. 1d., concentrating 3s. 6d., total 15s. 10d. The total cost including extra expenses due to the coal strike was £125,670, and the income from sales of lead concentrate and zinc tailing was £171,274, leaving a profit of £45,603. Out of this £2900 went in payment of administration expenses and taxes and £5166 was written off for depreciation. A dividend of £20,000 was distributed. As usual the report of the manager W. E. Wainwright contains much interesting matter.

Chillagoe.—This company is registered in Victoria and was formed in 1898 to work copper-lead deposits in North Queensland. It has been twice reconstructed, and the capital now stands at £500,000 in shares of 10s. each, in addition to which there are £773,000 debentures. The company also owns a railway from Mareeba to Chillagoe and has nearly completed a further piece of line 145 miles long to Einasleigh and Etheridge. The company has a smelting plant at which its own ores, those of the subsidiary Mungana company, and custom ores are treated. E. A. Weinberg is consulting engineer, E. J. J. Rodda is mine manager, and J. Horsburgh is metallurgist. The report for the year ended March 31 shows that the amount of ore raised from the company's own mines is much less than during the previous year; in fact the mines are for all practical purposes non-producing. The ore purchased from the Mungana company has been of less value than formerly. If it had not been for ore purchased from the New Einasleigh mine at Etheridge, which now promises to become a regular producer, the metallurgical work would have shown a great contraction; and even as it is the furnaces have only been running part time. The report shows that development has been done during the year only at the Zillmanton mine where work was resumed on August of last year. There is about 40,000 tons of copper ore available for extraction at this mine. Small shipments were obtained from the Redcap and Ruddygore mines and from the Calcifer and Boomerang dumps, but the total amount sent to the smelter was only 3000 tons containing about 2% copper and 1½ oz. silver per ton. The lead furnaces treated 20,051 tons of ore, mostly from the Mungana mine, and produced 2042 tons lead containing 137,318 oz. silver, and 5658 tons of matte containing 1061 tons copper and 140,111 oz. silver. The copper furnaces were occupied during the earlier part of the year in the treatment of this matte, but later on the Mungana lead-copper ore contained so much less lead and so much more silica that it was treated direct in the copper furnaces, so sacrificing the lead content. The amount treated in this way was 8290 tons. The copper furnaces also treated 16,964 tons of copper ore from New Einasleigh. The total output was 2735 tons copper, 283,860 oz. silver, and 1798 oz. gold. The profit for the year was £88,348 which was earned entirely by the railway, the mines and the smelters yielding none; out of this £26,540 was paid as debenture interest and £56,016 written off for mine development and for depreciation of plant. A great deal of work has been done in the investigation of other properties. Of these the most promising seems to be the Big Reef near Charleston, in the Etheridge district, which in earlier days was worked for gold in the oxidised zone, and now is being developed in the sulphide zone.

Golden Horse-Shoe.—As already recorded, the production at the Golden Horse-Shoe at Kalgoorlie has

fallen recently. At the meeting of shareholders in May the directors promised a special report by the manager, J. W. Sutherland. This has now been issued. His estimate of the ore reserves, revised on June 30, gives 903,592 tons averaging 10·32 dwt., as compared with 1,071,638 tons averaging 11 dwt. on December 31 last. The decrease in the tonnage is accounted for solely by the extraction of ore for the battery and not by the rejection of any parts included before. At the same time the reserve has not been increased, as the development work done during the half-year has been preparatory rather than final. The ore mined during the half-year has averaged 10½ dwt. It will be seen that the revised estimate does not reduce the content to the extent expected by many. Mr. Sutherland attributes the recent fall in the output to a combination of factors. First, some of the stopes were in poor ground; second, at other points the vein was more



KALGOORLIE.

faulted than was expected; and third, it happened that mining could not be done at other points where the ore was known to be richer. In addition, a few breakdowns of machinery occurred, in themselves of no great importance but, taken in conjunction with the other circumstances, caused further restriction of the output. Mr. Sutherland writes hopefully of the future. The directors have requisitioned the services of Henri Kuss, the French Inspector-General of mines, who will proceed to the mine to make an independent examination forthwith.

Hainault Gold.—This mine is situated at Kalgoorlie, to the west of the Kalgurli mine and to the north of Perseverance. It is controlled in Glasgow, and Archibald L. Hay is general manager. The metallurgical treatment is different from the usual method now adopted at Kalgoorlie and is an improved form of that generally in vogue in earlier days. Forty stamps crush to 8-mesh and deliver to 6 Cobbe-Middleton amalgamating pans which reduce it to 40-mesh. The tailing is classified and the sand concentrated on Wilfleys and the slime on canvas strakes. The concentrate is roasted in Edwards furnaces and cyanided, and the sand and slime is cyanided. During the year ended May 31, 69,068 tons of ore was treated and the total extraction from all sources was worth £93,639. This compares with 66,737 tons and an extraction of £76,355 during the previous year. The increase is due to the fact that the new plant for the treatment of the slime was put in commission. Mining, extraction, and development cost £77,000, depreciation £5907, administration £1712, and taxes £528, leaving a profit of £7451. A dividend of £7500 has been declared, being at the rate of 5%. The developments at the mine during the year have been satisfactory, and the ore reserve is estimated at 100,000 tons averaging 28s., figures practically identical with those of last year.

Komata Reefs.—This company was formed in 1897 to acquire gold mining property in the Hauraki mining district, New Zealand. It was reconstructed in 1900, and in 1902 the capital was increased in order to acquire adjoining property belonging to the Waitekauri company. Milling started in 1897 and the equipment now consists of 20 stamps and 2 tube-mills. The operations have however not been a success, and dividends have been small, the total having been only 16⅔% on £200,000 capital. A year or more ago it became evident that extensive development would be required in order to find additional ore, and as new capital was out of the question the policy was adopted of sending the best quality of ore to the mill and working it to such an extent only as would provide funds for development. The report for 1909 therefore shows a fall in the amount of ore treated, 13,390 tons being sent to the mill, or only one-half of the regular production. The extraction was worth £26,088 or 39s. per ton, 5s. higher than the previous year, and the assay of the tailing was only 2s. 6d. per ton. The percentage of recovery was 94% of the gold and 89% of the silver; 36% was saved by amalgamation and the remainder by cyaniding. The cost was £18,337, or 24s. 2d. per ton, and in addition £3516 was spent on development work. Other expenditure, such as London expenses and income tax, and sundry receipts ap-

pear in the accounts, and the result of the year's work shows a balance of profit of £2371. The result of development has been disappointing and hardly any new ore has been found. There was 20,900 tons of ore in reserve on December 31 last, and since then the mill has been treating about 800 tons per month. The outlook is not cheerful. For many years F. C. Brown, the inventor of the agitator known as the Pachuca vat, was manager. He resigned in March last.

Ferrobamba.—An extraordinary general meeting of this company owning the copper deposit in Peru referred to at length in our last issue was held on September 20, to confirm an agreement made by the directors with A. C. Burrage of the Amalgamated Copper Company. Mr. Burrage has bought the remaining 3500 shares at £3 each, the total issued capital being £120,000, and has obtained an option until May 1 next to purchase the entire property and transfer it to an American company. The purchase price will be £250,000 in cash, payment to be spread over four years and secured by bonds, and £420,000 in shares in the new company. Mr. Burrage will provide £730,000 as cash working capital for the development and equipment of the mines. In the meantime Mr. Burrage sends his engineers at his own expense to investigate, and their views as compared with those of W. E. Gordon Firebrace and Claude Vautin will be awaited with interest.

North Anantapur.—This company was formed in June 1908 by John Taylor & Sons to acquire and work part of the Dod Buruju gold property belonging to the Anantapur Gold Field Limited, in Madras Presidency, India. The report now published covers the year ended June 30 last and shows that the 10-stamp battery commenced work on May 20 and that, from that date to the end of the financial year, 516 tons of ore yielded 262 oz. of bullion worth £1031. The tailing assayed 2¼ dwt. per ton and will require subsequent treatment. The developments during the year were 2952 ft., and the reserve on June 30 was estimated by W. T. Harvey White, the acting superintendent, at 5500 tons. The ore is irregular and bunchy and its value is difficult to estimate, and much of the exploration work between the 350 and 450 ft. levels has been discouraging. Mr. White considers the northern part of the main lode beyond the North shaft to be the most promising part of the mine ; here two profitable orebodies have been found on the 150 ft. level.

Barramia Mining & Exploration.—This company was formed by John Taylor & Sons in July 1909 to acquire from the Egypt & Sudan Mining Syndicate the Barramia gold mine which is situated between the Nile and the Red Sea, 63 miles from Edfu on the Nile. The capital of the company is £55,000, divided into 216,000 10% non-cumulative preference shares of 2s. 6d. each and 112,000 ordinary shares of 5s. each. The purchase consideration was £28,000 in ordinary shares, £1350 in preference shares, and £5000 in cash. The remaining 205,200 preference shares were subscribed in cash by shareholders in the vendor and allied syndicates. The preference shares, in addition to the 10% dividend, are entitled to $\frac{27}{65}$ of the subsequent profits in any one year. The mine has a 5-stamp battery erected by the vendor syndicate. The property was worked by the ancients and it has the characteristic of containing ore shoots of high value. The vendor syndicate had extracted 1460 tons of ore which yielded gold worth £17,190. The work of the present company has been to prosecute developments. During the year ended June 30, 583 tons of ore was extracted yielding gold worth £15,727, and a profit of £3276 was made, so that it has been possible to distribute 10% on the preference shares, absorbing £2700. An additional 5-stamps and other plant are being added, and plans are being made for the provision of a cyanide plant for the treatment of the tailing which assays as much as 8 dwt. Motor traction is being established for communicating with Edfu to supplement the present camel traffic. The report by S. W. George, the superintendent, shows that the mine is in a promising condition and that in several places the ore is highly profitable. He foreshadows the provision of additional plant which will be required for the economical exploitation of the veins below the 250 ft. level. Mr. George is resigning owing to desert life not suiting his health and Arthur J. Rickard succeeds him.

Tomboy Gold Mines.—This company operating the Argentine mine in Telluride, Colorado, is one of the Exploration Company group. The report for the year ended June 30 shows that the output and profit have been well maintained as compared with the previous year, though on account of the fall in the average content the profit is less than one-half of what it was three years ago. The developments have kept pace with the extraction and the ore reserve is sufficient for four years. During the past year, 110,560 tons was sent to the mill, as compared with 102,000 the year before. By amalgamation and cyaniding, bullion worth $488,304 was saved, as compared with $487,486: the dressing plant produced lead and zinc concentrates that sold for $328,060, as compared with $332,970. There were other small items of income and the total receipts at the mine were $838,720, as compared with $832,569. The expenses at the mine were $530,383, as compared with $480,527, and the profit was $308,337, as compared with $352,041. There were other expenses, including administration, and the profit and loss account shows an income of £174,992, expenses £110,503, and profit £64,489. Out of this, £6357 has been allowed for depreciation, £4000 has been paid as income-tax, and £541 as commission to John Herron, the former manager. The year commenced with a balance in hand of £63,727 ; £60,000 has been distributed as dividend, being at the rate of 20%, and £57,318 has been carried forward. During the year 3555 ft. of development work was done and on June 30 the reserve was estimated by D. A. Herron, the manager, at 444,600 tons, as compared with 400,000 tons a year ago. The concentrating plant has been improved in several points of detail, with the result that a larger amount of ore can now be treated and cleaner lead and zinc concentrates obtained.

The illustration on the opposite page gives a view of the locality in which the Tomboy and Argentine mines are situated.

Globe & Phœnix. — The interim report of this Rhodesian gold mining company covers an abnormal period. The repairs to the main shaft were carried on intermittently for some months, and in the intermediate periods high-class ore was raised. In June the repairs were conducted continuously and completed at the end of September. During the months January to June the mill was at work 117 days, crushing 23,525 tons. By amalgamation and cyanide 43,328 oz. worth £183,058 were recovered. It will be seen that the ore treated was worth nearly 2 oz. per ton. The cost was £45,980 leaving a profit of £137,078. The cost per ton was 38s. 9d. as compared with 28s. 2d. during the previous year, a rise which is entirely due to the smaller amount of ore treated. Development work has been hampered, but nevertheless the reserve on June 30 was slightly greater than on December 31, the figures being 173,788 tons worth 32¼ dwt., as compared with 171,507 worth 31¼ dwt.

THE TOMBOY AND ARGENTINE MINES, COLORADO.

PRÉCIS OF TECHNOLOGY

Lead Acetate in Cyanide Practice.—In the *Mexican Mining Journal* for August, E. M. Hamilton opens a topic for discussion by questioning the utility of lead acetate in the cyaniding of silver sulphides. In his experience he has found many cases where the acetate has little influence on the solution of the silver and often even a deleterious effect on the solution of the gold. He considers that in starting a new plant the results may be improved by adding the acetate, yet if say nine months afterwards the addition is stopped no diminution in the extraction is observable. The use of acetate is based on the assumed presence of a soluble alkali sulphide. In the author's opinion the sulphide has only a momentary existence and there is usually sufficient oxygen present in the solution to oxidize it immediately, so that unless the ore has a marked reducing action there is no need whatever for acetate. The author has never found any soluble sulphide present, though sulphocyanide is usually found. If the ore has a tendency to remove free oxygen, the addition of acetate may be beneficial, but as already stated its effect may be greater at first than later. The explanation is that after a time sufficient zinc gets into the solution and acts in the same manner as the lead acetate. The author quotes J. S. Colbath, manager of the El Rayo mine, who once found his silver extraction fall off mysteriously. He added acetate but did not improve the extraction much, and in fact the extraction of the gold was decreased. On further examination he found an unwonted absence of zinc in the solutions, so he commenced to add it in the form of zinc cyanide. The extraction immediately became normal once more. The author invites other metallurgists to come forward with views and experiences on this subject.

Cyanide Practice at Esperanza.—The mill and cyanide plant at the Esperanza mine, El Oro, Mexico, was remodelled a year ago. The gold and silver are in an extremely fine state of division and for this reason it was found advisable to adopt a modern all-sliming and cyaniding plant. The new plant is described by the manager, Charles Hoyle, in the *Mexican Mining Journal* for August. Some of the ore is oxidized and other parts contain iron sulphides rich in the precious metals, and occurring in narrow veinlets. In mining and milling these two classes are kept separate, but after the sulphide has been removed by concentrators the two are treated in the same plant. The average content of the oxidized ore is 9½ dwt. gold and 2½ oz. silver; that of the sulphide ore is 25 dwt. gold and 6½ oz. silver. The sulphur content of the sulphide ore is only 1·2%, showing how much gangue has to be extracted along with the rich sulphide veinlets. No copper, lead, or zinc is present. The ore is collected in bins 150 ft. below the top of the shaft and is carried on belt-conveyors through a winding tunnel 1000 ft. long to the mill-bins. After breaking and sampling, the ore is sent to the stamps of which 40 treat the sulphide ore and 80 the oxidized ore. The battery and plant generally is driven by electric power. The weight of each stamp at present is 900 lb., but is being increased to 1250 lb. by lengthening the stems and increasing the size of the shoes, bosses, and tappets. No amalgamation is done, and the solution in the stamp-mill contains 0·12% cyanide. Lime is added to the ore during conveyance on the belts. The screens in the sulphide battery are 20-mesh and are made of No. 24 wire. The duty is 4 tons per day and the amount of solution used is 9 tons per ton of ore. The discharge from the mill contains 47·6% of material that passes 200-mesh. It goes direct to an Esperanza drag-classifier which separates it into sand and slime. The sand goes to steel spitzkasten with three compartments and the three grades here produced are sent to three sets of three No. 5 Wilfleys. The concentrates produced on these nine tables are re-treated on another Wilfley and the final concentrate is shipped to smelters. The slime overflow from the drag-classifier is too flocculent for concentration and goes direct to the thickening tanks where it is joined by the similar oxidized product. The tailing from the concentrators goes to the re-grinding plant along with the sand from the oxide plant.

Eighty stamps are used on oxidized ore. The screens are 12-mesh and are made of No. 22 wire. The duty is 5½ tons per day and 9 tons of solution are used per ton of ore. Of the discharge 36·8% will pass 200-mesh. From the battery the pulp goes to two drag-classifiers; the sand joins the sulphide tailing and goes to be re-ground and the slime overflow joins that from the classifier working on the sulphide ore and goes to the thickening tanks. The first set of thickeners consist of three tanks which produce a pulp containing 1 part of liquid to 1 of solid. The overflow still contains much solid matter and goes to 6 classifying tanks for re-settling. The slime here obtained joins the other and goes to Pachuca vats, while the solution is pumped to the storage tanks. There are 6 No. 2a. Pachuca vats, 44 ft. 8 in. by 14 ft. 10 in. This set is called the 'upper Pachucas.' Here the slime is agitated for 36 hours and then discharged into the sludge tanks which feed the Merrill filter-presses. The average fineness of the slime may be gauged by the fact that 92½% goes through 200-mesh.

The oxide and sulphide sand when discharged from the classifiers contains 33% moisture which is not sufficient to carry it along the launders, so further cyanide solution is added to carry it to the tube-mills. On its way it is passed through another drag-classifier to remove some of the *minus* 200 material which has come over with it from the other classifiers. There are 5 Krupp tube-mills 49 in. diam. and 19 ft. 8 in. long, revolving 32 times per minute. Each mill will treat 30 tons per day reducing to 200-mesh. This duty is not so great as was anticipated, so 4 more mills are being erected each 61 in. diam. by 22 ft. long. The low duty is explained by the fineness of the grinding and the hardness of the rock. Even now the grinding is not sufficiently fine to obtain a good extraction of the silver content, but as it is sufficient for the gold, no finer grinding would be economical. The pebbles in the mills consist of the hardest parts of the ore picked out on the grizzlies. From 3 to 5 tons of them are used in each mill per day. Though the consumption is large it is more economical to use the mine pebbles than to import Danish pebbles which cost 35 pesos per ton. The lining of the mills consist of sheet steel $\frac{5}{16}$ in. thick upon which is laid a grid consisting of bars held together with ribs. The only wearing part is the grid, which lasts about 6 months.

Until recently the discharge from the tube-mills was classified and the coarser portions returned, but at present the classification is omitted and the discharge sent direct to Pachuca vats. It was found that the efficiency of extraction was not appreciably increased by re-grinding nor was any choking in the vats caused by the presence of sand; on the other hand much expense in handling material was saved. There are 6 Pachucas, called the 'lower Pachucas,' of similar type to those already described, but the method of operation is different. In the upper Pachucas individual filling and discharge is used, but in the lower Pachucas

continuous agitation by cross-piping has been adopted. By this method the pulp is always charged into the first vat and it subsequently passes from the first into the others one after the other. The advantage obtained by continuous agitation is that much less time is occupied in charging the vats. It is intended to modify the upper Pachucas to the continuous system. It would be also more advantageous to mix the flocculent slime and re-ground sand and combine the two sets of Pachucas, but the two sets are on different levels, the upper ones discharging by gravity to the presses and the lower being 50 ft. below the sludge-tanks.

There are 3 sludge-tanks measuring 30 by 12 ft. The agitation is done by stirring arms revolving at 5 r.p.m., driven by mechanism fitted in concrete foundations below the tanks. The discharge from these tanks flows as a homogeneous stream to 5 Merrill filter presses. Two of the presses contain 90 three-inch frames and three contain 76 four-inch frames. The frames all measure 44 by 68 in. The reason for the difference in design is that the former were intended for the treatment of flocculent slime and the other for the re-ground sand, but the two are not now kept separate. The total capacity is 900 tons per day but 700 tons is the maximum amount treated so far. The pulp fed to the presses contains not more than 1½ parts of liquid to 1 part of solid. Filling occupies 30 min., washing 35 min., and discharge 45 min., a total of 1 hr. 50 min. About 2½ tons of wash water is used per ton of solid and 4 tons is required to sluice out the presses. Most of this water is recovered in the dewatering tanks. The presses are filled under a pressure of 22 lb. per sq. in., the wash water is introduced at 40 lb. and the sluicing water at 60 lb.

The solutions and wash water are treated with zinc dust. This is spread in a thin layer on a short belt-conveyor, and fed automatically into the suction of the pump which lifts the solution to Merrill precipitate presses. These presses treat 500 tons of solution and 1000 tons of wash water per day. No attempt is made to obtain a perfect precipitation from the solution, as it is used over and over again. In this way the grade of the solution becomes high, a condition favourable to the process of precipitation. The author in his paper also gives details of the dewatering apparatus which is an important feature of the plant. There is not enough water obtained from the mine and some has to be bought from outside sources. It is therefore necessary to practice every economy to save consumption of water.

Copper-Nickel Steel.—In our last issue we gave a précis of papers dealing with copper-nickel alloys and copper-nickel steels. With regard to the latter the experiments quoted referred to laboratory work using electrolytic iron and not commercial iron and steel. *Metallurgical and Chemical Engineering* for September contains contributions by G. H. Clamer and John A. Mathews presented at a recent meeting of the American Society for Testing Materials, both dealing with commercial copper-nickel steels. Mr. Clamer points out that the best proportions of nickel and copper for addition to steel are those found in nature in the Sudbury ores, which already are being used for the production of 'monel' metal. He goes a step farther and shows that copper-nickel steel itself can be produced direct from these ores by smelting, bessemerizing to eliminate the iron to the extent desired, roasting the matte produced, and reducing the combined oxides thus obtained. Either by this direct reduction or by the addition of monel metal to steel, a product can be obtained that would be cheaper than nickel steel and would be in demand for many purposes where strength

THE ESPERANZA MILL.

and incorrodibility are desirable. The results obtained by Mr. Clamer show that alloys containing 5 to 20% copper, which without nickel would be hard, brittle, and red-short, become by the addition of 20 to 50% nickel highly ductile, and easily forged and machined. A steel containing 9% copper, 22% nickel, and 0·22% carbon had the following characteristics: Ultimate strength 101,000 lb. per sq. in.; elastic limit 57,300 lb.; elongation 42½%; reduction in area 61½%. Similar figures for a steel containing 19½% copper, 45% nickel, and 0·20 carbon were: 98,230, 54, 150, 35, and 47·9 respectively. These steels will be suitable for structural sheets, being much stronger than mild steel or copper sheets, and having a low coefficient of expansion as well as being able to resist corrosion. By comparing the figures of elastic limit and ultimate strength it will be seen that the steels are pliable. Mr. Mathews described in his paper the smelting of Canadian iron ores which happen to contain nickel and copper. The steel produced contains 3½% nickel, from 0 to ½% copper, and ½% carbon and the author has manufactured it both by the Heroult electric furnace and by the open hearth. His figures for results are somewhat similar to those of Mr. Clamer and he shows that the presence of the small amount of copper has no deleterious effect.

In all probability these investigations by various metallurgists will open up a profitable field of application for ores hitherto classed as valueless.

Metallic Coatings. — In a communication to the Zurich Association of Engineers and Architects, published in *Revue de Metallurgie* for August, H. Schoop describes a method of coating articles with metal by projecting upon them a stream of finely divided metal. A thin stream of the liquid metal is forced from an orifice and atomized by a jet of vapour or gas. The article on being moved rapidly through the metallic cloud so obtained, becomes coated with a layer of metal, and the operation occupies from one to three seconds. The atomized metal as it arrives at the surface to be covered is not in a liquid condition, and the adhesion of the coating is explained by the great velocity of the jet. The hardness of the layer is notable and the adherence may be judged by the fact that pieces of iron tinned by this process have been folded 10 to 12 times without any scaling taking place. The coating metal may be tin, zinc, or lead, and as no previous heating of the article is required the process is readily applicable to large structures such as bridges. Metallic surfaces should be free from any trace of dust or oxide before treatment, either by sand-blasting or by cleaning with acid. It is possible to atomize alloys by this method, but the results indicate that a homogeneous atomization is only obtainable in the case of the eutectic alloy. Although the metal and the gases employed may be heated to a high temperature, the zone of metallic vapour is relatively cool, an effect which is produced by the sudden expansion of the gases at the orifice of the blast. It is therefore possible to coat objects which have a low point of fusion or combustion, such as paper, wood, and even celluloid.

Iron Industry of Mexico.—In the *Iron Age* for September 8, John Birkinbine contributes a timely article on the iron and steel industry of Mexico. The progress of this republic in the mining and metallurgical arts has been gratifying. Formerly only notable for silver, it is now an important producer of gold and copper. Oil is now being added to its commercial resources. For two hundred years enormous deposits of high class iron ore have been known and worked and it is only the absence of good coking coal within its boundaries that has hindered the establishment of an extensive iron and steel industry. In the early days of Spanish rule, these deposits were worked and the ore smelted in the Catalan forges, charcoal being the fuel; but the depletion of the forests in the neighbourhood of the mines caused one after another of the iron works to be closed. There are however many still surviving. As regards the coal resources of the republic, deposits are found in Coahuila in the north not far from the Texas boundary, and prospecting and development is being done in Sonora and in Oaxaca. The Coahuila properties are the only active producers and the most important are those at Sabinas. The coal belongs to the Cretaceous age and is high in ash and sulphur. The output is about 1,000,000 tons per year. In order to make a metallurgical coke it is necessary to break and wash, but even now the coke produced contains 15% ash. Another drawback is that the coal is not near the iron deposits so that railway haulage adds to the cost. Much coal and coke is imported from Europe and the United States, and here again long and steep haulage on the railways is required. The industrial development of the republic has been great and large quantities of iron and steel are imported every year for the railways and other purposes. The most important iron and steel producer is situated at Monterey, and is known as the Monterey Iron and Steel Co. This is marked (1) on the map. Capital was supplied by natives of the republic and the management and most of the employees are Mexicans, but the plant was designed and made in the United States. There is a blast-furnace capable of producing 300 tons per day, three 35-ton open-hearth steel furnaces and a small bessemer converter. Heating of the steel furnaces is done by gas-producers. The steel-works contain rolling-mills for rails, structural shapes, merchant bars, etc. The iron ore comes from various mines in the northwest of Mexico, and from the Iron Mountain at Durango. Coke and coal come from Sabinas and also from abroad being imported through the port of Tampico. Pocahontas coke is the one preferred. Oil fuel is used in some of the operations, notably in the manufacture of bolts, nuts, and rivets. The company has recently contracted with the National Railways of Mexico to supply 85-lb. steel rails. Some of these have already been laid on the line between Mexico and Queretaro. The contract calls for 32,000 tons of steel rails during 1910, in addition to other railway material. The analysis of the steel rails shows 0·7% carbon, 0·8% manganese, 0·14% silicon, 0·035% phosphorus, and 0·044% sulphur.

Another iron producer of note was the Piedra Azul works at Durango. This plant was in operation for many years but was closed in 1890. In 1884 another smelting plant was erected at Durango, (2) on the map, by the Mexican National Iron and Steel Co. and elaborate steel-making plant was provided, but metallurgical troubles of all sorts cropped up, and there were disputes among the shareholders, so that the venture has been unsuccessful. These two companies had the advantage of the immense mountain of ore, but were handicapped by scarcity of good charcoal and by the absence of means of transport. In the state of Jalisco two works have been erected, see (3) and (4). One of these, the Marta Cristos, was founded in 1875 but has been inactive for the last 10 years. The other the Ferreria de Tula at Zapalpa has a blast-furnace producing 15 tons of pig iron per day with a consumption of 1·2 tons of charcoal per ton of pig. This company has a rolling-mill and supplies iron to Guadalajara, Aguascalientes, Manzanillo, and adjoining districts. The control is in Boston and it is announced that the plant is to be greatly extended.

An interesting group of iron producers is that controlled by Richard Honey who for 35 years has operated many blast-furnaces. Those now in commission are in the state of Hidalgo and in the Federal District. The Encarnacion (6) and San Miguel (7) have blast-furnaces using charcoal and rolling-mills; the Apulco (8) has a blast-furnace and a foundry; and the Delicias (9) has a rolling mill only. It is interesting to note that at the last-named an electric furnace is to be installed before long. There are in Mexico a great many other rolling-mills and foundries which use imported iron, some of them of considerable importance, but it is not

MAP OF MEXICO, SHOWING DISTRIBUTION OF IRON WORKS.

the author's intention to describe any but those using iron smelted on the spot. The author describes a large number of Catalan forges that have survived in various parts of the country. One of the interesting circumstances relating to Mexican iron smelters is that their altitude is great. That at Durango is 6300 ft. above the sea; that at Tula 7300 ft.; the Encarnacion 7650 ft.; Apulco 6950 ft.; San Miguel 5400 ft.; and the Delicias 7250 ft. The Monterey plant is the lowest being only 1600 ft. The results of smelting with this dry rarefied air are of importance and deserve further description.

Iron Ore Resources of France.—P. Nicou in the *Bulletin de l'Industrie Minerale*, and *Revue de Metallurgie*, September 1910, shows that France, while poor in fuel resources, possesses, on the other hand, an enormous reserve of iron ore. It is probably, in this respect, one of the richest countries in the world, its resources having been estimated at 3,500,000,000 tons, without reckoning 100 to 150 million tons in Algeria and Tunis. The ores for the greater part are phosphoric as in Lorraine; but non-phosphoric ores are found in the Pyrenees Orientales, and in Algeria and Tunis. From a mineralogical point of view they may be divided into oolitic hydrated oxides as in Lorraine, brown hematite in the Pyrenees Orientales, Brittany, and Algeria, non-oolitic hydrated oxides in Gard, Berry, etc., red hematites in Normandy and Algeria, carbonates in the Pyrenees Orientales and Normandy, and a few others. The annual production of iron ore in France, including Algeria, amounted, in 1908, to 11,000,000 tons; but, although constantly increasing, these figures are still far from the point which will be reached when the Lorraine basin is fully exploited. The output in that district represents 85 to 90 per cent. of the whole production of the country, and amounted, in 1909, to 10,685,000 tons, the development being most rapid in the Briey basin. The lode extends into German Lorraine and into Luxembourg, where however its exhaustion will be more rapid since it has been worked there for some time. The thickness of the formation varies from 25 to 50 metres and it is estimated that there are, in the four basins of Nancy, Briey, Crusnes, and Longwy, through which the vein extends, at least 3,000,000,000 tons of ore. This ore is an oolitic hydrated oxide, the grains of which are embedded in an argillaceous or a calcareous rock. The content of iron is variable and ranges between 33 and 40 per cent. At Auboué in the Briey district, for example, the layer is calcareous,

whilst in the recently discovered Crusnes region the beds are decidedly silicious.

The Western Silurian basin includes the Normandy beds and those of Anjou and Brittany. In Normandy, the ore is a hematite or a carbonate and is usually somewhat silicious. At least four synclinals are known, having a thickness varying from 1·5 to 2 metres in the exploitable parts, but a great deal of exploration work will be necessary before any valuation of the ore reserves can be given. The production, in 1909, exceeded 400,000 tons. The ores of Brittany are rich in iron, 41 to 62 per cent., and are silicious, about 16 per cent. of SiO_2; at the same time phosphorus content is rather high, 0·30 to 0·75%.

The districts of the Pyrenees Orientales furnish the purest ores in the country. The veins lie irregularly in the Silurian strata and consist usually of hematite or spathic ores of variable richness; the thickness of these sometimes diminishes to less than one metre. These ores contain as a rule only traces of sulphur and phosphorus and not more than 5 to 10% of silica and 1 to 4% lime. Moreover, they acquire an additional value by reason of the comparatively high content of manganese (3 to 4%). The production, in 1908, amounted to 400,000 tons.

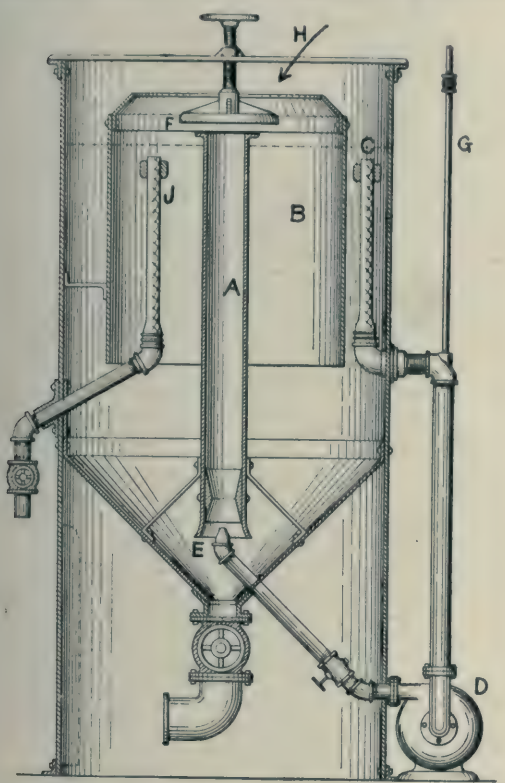
Coming finally to Algeria and Tunis, in which countries the reserves are estimated at 100 to 150 million tons, the most important lode, as regards production, is at Beni-Saf which furnishes annually more than 400,000 tons of red hematite containing about 0·25 to 0·30% of phosphorus but no sulphur. Other important deposits, as yet not worked, are those of Ouenza, in Algeria, and Djebel Djerissa, in Tunis; at the latter district there is 15,000,000 tons of a rich hematite ore of very low phosphorus content.

Manufacture of Chlorine at Mount Morgan.—At the recent meeting of the Australasian Institute of Mining Engineers held at Mount Morgan, B. Du Faur read a paper on the electrolytic production of chlorine used in the chlorination works. The cells are made of iron and each is divided into three compartments by means of perforated iron sheets the inner surface of which is covered with asbestos cloth which acts as the diaphragm for keeping the caustic soda away from the chlorine. The bottom and ends of the middle compartment are covered with cement to keep the chlorine from attacking the iron. The middle compartment is the anode chamber and the two outer ones the cathode chambers. Acheson graphite is used as the anode and is held in place by hard-lead holders. The cell is covered with earthenware and is made gas-tight by a covering of pitch. As usual in these cells the chlorine gas comes away from the anode and caustic soda is produced in the cathode chamber. Special means are employed for preparing a pure form of salt, as the available crude salt contains much magnesium chloride and sulphate of lime and otherwise would soon clog the anode chamber. The crude salt is dissolved to a strength of 3 lb. per gal. and delivered into a vat to which the requisite amount of caustic soda and soda ash has been added. The soda ash precipitates the sulphate of lime as carbonate and the caustic soda precipitates the magnesium chloride as hydrated oxide. As the amounts of these impurities are continually varying it is necessary to keep on the lookout for excess of free alkali. If there is an appreciable amount of this left in the brine it will cause the liberation of oxygen in the anode chamber instead of chlorine. Long experience has shown that 3 lb. salt to 1 gal. water is the most economical for use in the cell. From this 1 lb. of chlorine is recovered and the remaining 0·8 lb. is unaffected by the current; some of the undecomposed salt passes into the cathode chambers and the remainder goes into the overflow. It is found advisable not to let the strength of solution in the cathode chamber rise higher than 8% of caustic soda, for otherwise some of the caustic soda spreads by diffusion into the anode chamber and not only re-combines with the chlorine but also rapidly destroys the anode. The cathode chambers are therefore emptied once every 24 hours, but the anode chamber need only be opened every 6 months as the anode will last that long if the above precautions are observed. The amount of current used in each cell is 350 amperes or 54 amperes per square foot of anode surface. Twenty cells are used and are connected in series. At the beginning of a run with new anodes the voltage is 88, but this gradually increases as the anodes disintegrate and at the end of 6 months is 98. During a 6 months' run, the average daily production of chlorine was 312½ lb., so that the mean power consumption per lb. of chlorine was 2½ kilowatt-hours. With regard to economizing the brine, it is found advisable to extract by means of a vacuum filter as much as possible of the salt solution remaining in the lime and magnesia sludge. If the caustic soda is recovered from the anode chambers by evaporation the salt in it is separated by crystallization and so recovered. The author does not say definitely that the caustic soda is allowed to go to waste but apparently it does, except such as is required for the precipitation of the magnesium chloride.

The Tooele Smelter.—E. P. Mathewson describes the new International smelter of the International Smelting and Refining Company recently erected at Tooele a short distance south of Bingham, Utah. This description was published in the first annual report of the company. The copper concentrate of the Utah Consolidated is in future to be smelted here instead of at Garfield, and a contract has also been signed for the treatment of the concentrate from the South Utah company's mines. There are two roaster buildings each containing 16 McDougal furnaces. The capacity of each furnace is 40 tons of dry ore per 24 hours. The gases from the roasters go to a large dust chamber in which is suspended a system of wires for catching the dust and fume, similar to that in use at the Great Falls smelter. The gases are discharged through a stack 350 ft. high and 25 ft. diam. inside. The roasted ore and the dust is delivered by cars into hoppers immediately over the reverberatories. The smelting plant consists of 5 reverberatory furnaces similar to those at Anaconda, and having hearths 102 by 19 ft., and capacities of 275 tons of roasted material each per day. The converter building immediately adjoins and contains 5 converters. There is a compressed-air tamping plant at one end of the converter building, and a 60-ton crane is installed in the main aisle for moving heavy material, slag, etc. The matte from the reverberatories is tapped direct into the converters, and the slag from the converters is taken in large ladles by cross cranes to the reverberatory furnaces and poured in hot. This makes a minimum amount of cold slag to be handled. The copper from the converters is transferred in ladles to the moulds in the casting shed adjoining. A casting machine will be erected later. The buildings are mostly made of steel and reinforced concrete and very little wood is used. The gases from the reverberatories pass through four boilers and there are in addition three coal-fired boilers. The power plant consists of two triple-expansion vertical engines each connected direct with 700 kw. alternators which supply motive power throughout the smelter, together with steam engines used for generating the blast for the converters and for compressing air. The smelter

started operations in August as already announced in these pages and it is not yet working at full capacity, as the output of the Utah Consolidated is at present curtailed. The smelter has no blast-furnace, as the whole of the material treated is likely to be fine concentrates.

Cyaniding Slime.—In the *Mining and Scientific Press* for August 20, John M. Nicol describes a new agitating vat for the treatment of slime, invented by W. C. Paterson, of Denver. This vat is being applied in the United States and in Mexico, and we are informed that South African houses are about to try it. We have in recent issues referred to A. F. Crosse's method, and the method at Santa Natalia, Mexico, for circulating slime in a vat by means of an air-lift and



obtaining a zone of clear solution between an internal cylinder and the body of the vat, this clear solution being continually decanted and sent to the zinc-boxes. Mr. Paterson's vat has the internal cylinder (*B*), and the clear solution is obtained in the annular space between this and the walls of the vat, but the application of the idea is different from those above-mentioned. The principle of the vat is to obtain a circulation of the slime and solution by means of a pump and not by an air-lift, and the object of having the internal cylinder is to be able to send a clear solution through the circulating pump instead of slime. Referring to the illustration, the clear solution is drawn off through the flexible tube (*C*) and forced by the pump (*D*) through a nozzle (*E*). The upward jet carries the slime from the bottom of the vat up the central tube (*A*). The current impinges on the baffle (*F*) and being spread sideways returns to the interior of the cylinder (*B*). If any extra air is required for aeration, some may be drawn in through the pipe (*G*). In practice these vats are arranged in series and continuous feeding and discharge is used. The slime and solution enters at (*H*) and leaves through the pipe (*J*) to go to the next vat. At the end of the process the clear liquid may be decanted through (*J*) and the solids discharged from the valve in the bottom, or the whole may be sent direct to the filters, according to the method employed. The advantages claimed for this process as compared with the air-lift are: first, that less power is required for the agitation, second, that excessive aeration is avoided, and third there is no foaming.

Sulphuric Acid as a By-product in Copper Smelting.—In the *Engineering and Mining Journal* for September 17, F. J. Falding and J. Parke Channing contribute an article reviewing the practicability of utilizing the sulphurous acid, produced in pyrite or semi-pyrite smelting, for the manufacture of sulphuric acid. They take specimen cases with different amounts of sulphur in the charge and first show how to calculate the amount of coke required to make up for deficiency in sulphur and then proceed to show the nature of the gases produced. The paper also contains a discussion of the conditions favourable to the successful production of acid from such charges, and of the commercial problem as to the circumstances under which the recovery of the sulphur is profitable. The authors take three specimen charges: (*1*) Containing 32% of sulphur over that required for the matte and 40% iron; this proportion of sulphur will provide sufficient heat and no coke is added. (*2*) A charge with 22% excess sulphur and 40% iron; as compared with (*1*) this will require the addition of 3·15% of 85% coke. (*3*) A charge containing 12% excess sulphur and 25% iron; this will require 8·86% of 85% coke. In addition to the amount of air required to oxidize the coke and sulphur, it is necessary to admit either at the tuyeres or elsewhere a further amount so as to give the necessary proportion of free oxygen required to change the SO_2 to SO_3 in the acid plant. In arranging this extra proportion care must be taken that there is no excess of coke in the charge; otherwise the furnace gases will contain so much CO_2 as to vitiate the reaction in the acid plant. Also it must be ascertained that this extra air will not interfere with the smelting operation. On these points will depend the policy of admitting the extra air at the tuyeres or above the charge. The great difficulty is that owing to the variations in the oxidizable content of the charge it is impossible to rightly proportion the exact amount of air to be admitted either through the tuyeres or above. It is obvious that great precision is necessary in preparing the charge so as to get a constant composition. For instance the charge should be thoroughly mixed, and consist of pieces of approximately the same size; also the method of charging should be altered so as to obtain more regular distribution, and smaller and more frequent additions to the charge. So far it has been supposed that only one blast-furnace is in use. Of course greater regularity of the content of the gases would be obtained if several furnaces were at work and their gases intimately mixed before going to the acid plant. The authors then proceed to calculate the constitution of the resulting gases in cases (*1*), (*2*) and (*3*). The oxygen required to oxidize the sulphur, iron, and coke, and the additional oxygen to transform the SO_2 into SO_3, are calculated, and also the amount of nitrogen associated with the oxygen of the air; and an additional 5% of oxygen is allowed. The resulting gas in case (*1*) which has no coke in the charge is composed as follows: SO_2 8·5% by volume, oxygen 10%, and nitrogen 81½%. In case (*2*) the composition would be: SO_2 7·1%, CO_2 2·3%, O 8½%, and N 82·1%;

and in case (*3*) : SO_2 4·4%, CO_2 7·3%, N 81·3%, and O 7%. The first two gases would be suitable for sulphuric acid manufacture, but the third would not be desirable unless circumstances were such that costs were low and the acid had a local market.

There is a general misapprehension that as the sulphur costs nothing the acid can be made at a low price. Sulphur is of course the chief item of expense to the sulphuric acid manufacturer who has to buy pyrite or other sulphide, but this cost is more than counterbalanced by other items of expense and trouble when the acid works draw their supply of sulphur from the smelter. For instance the cost of changes in the smelter and in the method of charging the furnaces, and the drawback of having to use an impure gas containing varying amounts of sulphur and impurities. The chemical manufacturer employs kilns which exactly suit his purpose and if using pyrite, can extract copper, if any, from the cinder, and can sell his spent pyrite to the iron smelter. Another consideration is that the sulphurous gases from roasting furnaces can be more profitably applied to the manufacture of acid than those from blast-furnaces, and in America much acid is produced in the central states from the furnaces used in roasting zinc ores from Missouri, Wisconsin, and even Colorado. It is also necessary to take the cost of freight into account. The world over it is well known that it is easier to ship sulphide ore than sulphuric acid ; both on sea and land this acid is an undesirable article of freight. It is one of the fundamental principles of chemical engineering that acid should wherever possible be made on the spot where it is to be used.

Metallurgical Laboratory at the South African School of Mines.—In the issues of August 6 and 13, *The South African Mining Journal* describes the new ore-dressing and metallurgical laboratories at the South African School of Mines, Johannesburg, which was formally opened on August 5 by General Smuts, the Minister of Mines. In the design of the laboratory two ideas have been kept in view ; one to give the student practical instruction in the working and theory of the various processes, and the other to provide means for testing the ores found in South Africa and investigating the best method of treatment. The plant has been chosen in such a way that almost any ore can be treated in a great variety of ways. South Africa is so much identified with gold that it is sometimes forgotten that other metals are found there. Though these do not yet yield large returns, the development of the ore deposits is of importance to the community. Tin is beginning to come forward, and copper, zinc, and lead will follow. Hence the metallurgical laboratory has been designed for the treatment of this class of ore as well as those of gold.

The ore-dressing department contains a rock breaker, a 3-head prospector's stamp-battery, ball-mill, rolls, Harz jig, Collom jig, grinding pan, Wilfley, Frue vanner, Evans slime table, Cornish buddle, and rag frames ; also classifiers and dewaterers. In the metallurgical section there are slime treatment vats ; one has both rotating arms and a pump circulator for agitation purposes, and the other is a Brown agitator or Pachuca vat. A barrel agitator is provided for chlorination tests and for tests with acid solutions. There is a small suction filter which is advisedly called the ' Butters or Moore ' filter, and also one of the older type of filter-press. An air-compressor and exhauster completes this part of the outfit. In another part are built a roasting furnace, reverberatory, blast-furnace, large pot-furnace, retorting furnace, and desilverizing kettle. There is also a small electric furnace, and electro-deposition vats. The assay rooms are extensive and are provided with the usual apparatus. A room for metallographic study contains microscopes, microphotographic apparatus, pyrometers of all sorts, and calorimeters. A museum has been added to the School, and it already contains a very fair collection of models. For instance the shaft-timbering at Driefontein Deep is shown in miniature ; this is a notable piece of work and has seven compartments. Various systems of winding apparatus are shown, and there are models of a great number of tube-mills, rock-drills, and concentrators.

The variety of purposes to which the laboratory may be used may be judged from the following outline of metallurgical schemes :—

Free-milling gold ores : Stamps, amalgamating, classifiers, regrinding, percolation of sand, decantation of slime, or, alternatively, filter-pressing or suction-filtering of slimes, zinc precipitation.

Refractory gold ores : Stamps or ball mills, concentrating, roasting and chlorination, or fine grinding and cyaniding.

Silver ores : Fine grinding, concentrating, air agitation with cyanide, or pan amalgamation.

Tin ores : Stamps, classifiers, Wilfley table, or vanner, slime table, and Cornish frames ; dressed tin smelted in reverberatory furnace.

Lead ores : Rolls, trommel, classifiers, jigs and buddle ; galena smelted. Alternatively, smelting in blast-furnace without previous concentration.

Copper ores : Same as lead ; Wilfley table, smelting dressed or raw ore in reverberatory, or raw ore in blast-furnace, with production of matte.

Zinc ore : Concentration as for lead ; roasting and extraction by distillation, or wet electrolytic method.

Coal : Washing and coking.

Electrolytic deposition and refining of metals can also be carried out, but electro-magnetic and electrostatic separating, oil flotation processes, electric-furnace smelting, etc., can only at present be tried on a laboratory scale, a few ounces or pounds at a time, though larger appliances will be installed later.

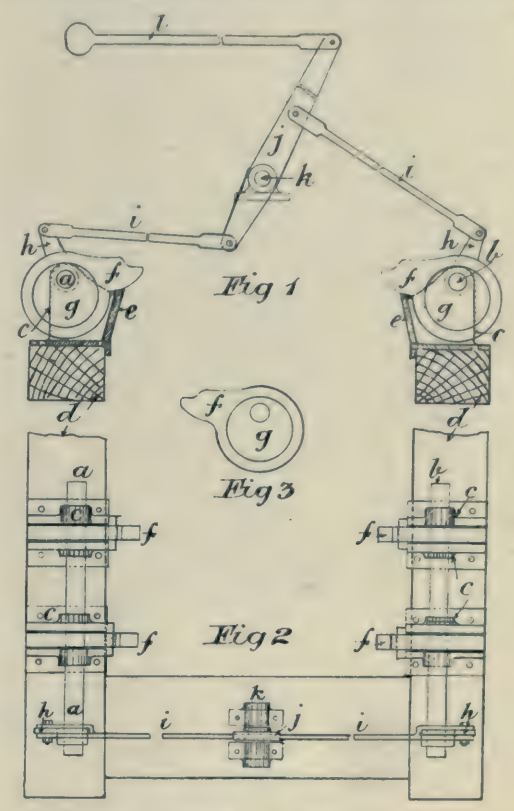
Lead Smelting at Trail.—The smelter at Trail, British Columbia, belongs to the Consolidated Mining and Smelting Co. of Canada, and treats copper ore from the Centre Star at Rossland and from the Snowshoe at Boundary, and lead ore from the St. Eugene in East Kootenay, together with custom ore of all sorts. During the past year the value of the metal produced in the furnaces was six million dollars of which 40% was gold. *Mines and Minerals* for September gives a long article by J. M. Turnbull on the working of the smelter, and we abstract from this the details relating to the lead smelting. The method of treatment is roasting by the Huntington-Heberlein process, converting, and smelting in blast-furnaces. The lead ore is mainly heavy sulphide, and about 20% is dry gold and silver ores, oxidized lead ore, and pyrite concentrates. The heavy sulphide is treated in seven Huntington-Heberlein furnaces 26ft. diam. with hearths revolving once in 3 minutes. Stationary cast-iron rabbles are arranged so as to carry the ore through the furnaces in 2 hours. The firebox and discharge are at the periphery and the feed at the centre, so the heat is greater towards the end of the roast. Limestone and lead matte are added to the sulphide so as to make the charge have the following composition : Lead 40 to 44%, iron oxide 10 to 13%, silica 8 to 11%, lime 7 to 10%, and the zinc is kept as much under 10% as is possible. The iron should preferably be 1 or 2% higher than the silica ; an excess of 2 to 4% of silica leads to serious trouble in the blast-furnace, by send-

ing more lead into the slag and making the charge too fusible. The material on entering the roasters contains 14 to 17% sulphur, and on leaving 8 to 9%. The temperature is kept at a dull read heat and care has to be taken to prevent it getting so high as to cause fusion. The discharged product consists of small, uniform, semi-fused globules showing neither limestone nor ore. This product is sent to the converter bins and on its way is sprayed with water. About 5% of moisture is thus added; this prevents the converter blast from blowing through too quickly. There are 24 converters, each 8 ft. 8 in. diam. with cast iron diaphragms made in four sections and bolted together. A wooden fire is started in the converter and when well alight 10 tons of charge is introduced and a blast of 10 to 12 oz. turned on. The iron, sulphur, etc., are oxidized and a mass of porous sinter produced. This is dumped upon an iron cone and thus broken into large pieces which are afterwards passed through a Blake crusher and reduced to 6 in. size.

There are two lead blast-furnaces, measuring 45 by 160 in. and 45 by 140 in. respectively at the tuyeres. The height of the charge is 17½ ft. above the tuyeres and the blast used is 32 to 34 oz. At the present time only one is in commission and produces about 75 tons of lead bullion per day. The charge usually consists of 85% of the sintered ore, 12½% of coke, and the remainder is composed of oxidized ore, silicious ore, limestone, and slag from the copper furnace. The lead in the charge averages 40% and has been as high as 50%. Sulphur is kept below 4%, and the speed of operations markedly falls on even a small increase above this. The average analysis of the bullion produced is: Lead 98½%, silver 100 oz., gold 0·1 oz., copper 0·22%, zinc 0·098%, bismuth 0·0133%, arsenic 0·28%, and antimony 0·32%. The slag is kept at 31 to 33% silica, 18 to 20% lime, 24 to 30% iron and manganese oxide (*FeO*, *MnO*), 7 to 12% zinc oxide and 8 to 16% alumina. It carries about 0·4 oz. silver and 1% lead. With high zinc the lime is reduced to keep the slag fluid. The proportion of silicious ores added to the charge is determined so as not to bring the silica in the charge much above 33%, as otherwise the furnace begins to work slower. The furnaces used to have tuyeres 20 in. apart, and more recently smaller tuyeres 15 in. apart have been used, but with no great difference in results. The bullion is tapped at the side of the furnace into a kettle of 50 tons capacity, from which it is sent by means of a 1½ in. centrifugal pump into vertical anode moulds. These anodes are then sent to the electrolytic refinery where the Betts process is used. The slag is granulated and delivered by means of a launder to settling pits. At present it is being sent to fill up a depression in the ground near Trail town that is being levelled for the convenience of the community. The whole of the smelter is provided with electric power generated at Bonnington falls 33 miles away. The smelter is on the Columbia river and is served by the Canadian Pacific Railway. Coke comes from Fernie in the Rocky Mountains.

The copper smelting plant contains five blast-furnaces 42 in. wide and varying from 240 to 300 in. long. The height of the charge is 9 ft. above the tuyeres. The Rossland ores are smelted raw and the first matte produced averages 15% copper. This matte after roasting is sent together with Snowshoe raw ore to the high-grade furnaces. The low-grade matte contains 27% sulphur and 56% iron, and after roasting in O'Harra furnaces so as to reduce the sulphur to 10 to 12%, is treated in the lead converters and the sulphur reduced to 1 to 3%. A small proportion of ore high in copper and low in sulphur is added to the roasted matte and Snowshoe ore when charged into the high-grade furnaces. The high-grade matte is shipped to Tacoma for further treatment, and some of the slag from the high-grade furnace is added to the charge in the lead blast-furnaces so as to recover some of the gold.

Support for Pit-Cages.—At the September meeting of the Midland branch of the National Association of Colliery Managers, F. M. Brown read a paper describing the mechanism invented by him and Joseph Hartley for supporting pit-cages at the top while changing cars. The paper is reported in the issue for September 16 of the *Iron and Coal Trades Review*. The advantage claimed for the mechanism is that it is



Support for Pit-Cages.

not necessary to first raise the cage in order to remove the support before the cage can descend. At the Stanley pit in Derbyshire where the apparatus is at work the time saved on each journey is appreciable and the output of the mine has been increased by 10%. The accompanying illustration shows the four supports (*f*) made of steel, fitting loosely on eccentrics (*g*) which are keyed to the shafts (*a*) and (*b*). The levers (*h*) fixed to these shafts are connected by links (*i*) to the lever (*j*) which is operated by the handle (*l*). The normal position of the apparatus is as shown. When the cage rises it pushes the supports (*f*) upward, and after it passes, the supports fall back in place. When it is desired to lower the cage again the handle (*l*) is pulled at the same time as the signal is given to the engineman. The partial revolution of the eccentrics (*g*) draws back the supports (*f*) and allows the cage immediately to descend.

BOOKS REVIEWED

THE GEOLOGY OF NEW ZEALAND; An introduction to the historical, structural, and economic geology. By James Park. Cloth, 8vo. 488 pages. Ill. London: Whitcombe & Tombs, Ltd. Price 10s. 6d. For sale by *The Mining Magazine*.

The sub-title is a modest description of a valuable volume. The author is professor of mining geology in the University of Otago and was formerly field geologist in the first Geological Survey of New Zealand. He is also well known as the writer of several interesting articles and pamphlets on the economic geology of the antipodean Dominion. No one is better fitted to write on the subject to which this book is devoted, and it is a subject presenting many features of unusual interest. The historical review recalls the labours of a succession of competent observers from Hochstetter and Haast to Hutton and Ulrich, from the first Survey under Hector to the second under Bell, together with such assistants as S. H. Cox, William Skey, and James Park, the present author. The physiography of the three islands constituting New Zealand, the geologic structure of a country characterized by glaciers on one hand and by active volcanoes on the other, the petrography of an extensive region rich in a variety of mineral resources, among which coal and gold are prominent—all these are described in successive chapters, illuminated by excellent sketches, maps, and photographs. We note particularly the account of the Tarawera eruption, the closing stages of which were witnessed by Mr. Park, who made a careful study of the evidence available. The evidences of past glaciation and the action of existing glaciers are described faithfully. Owing to his field-work among the coal mines, all of which have been inspected by Mr. Park, he is able to give a concise and comprehensive account, coordinating the various deposits and furnishing a reliable comparison of their industrial value. One chapter is devoted to the goldfields; in these 40 pages the author has compressed a large amount of useful information, especially as regards the alluvial deposits, which have been so productive. Not the least valuable portion of the book is a complete bibliography and a carefully prepared index.

In these days of raw compilations and sketchy bookmaking it is a pleasure to examine a volume prepared by so competent an authority and written with such conscientious care. We congratulate Mr. Park and also his publishers, who have done their part in a manner highly creditable. T. A. R.

THE GEOLOGY OF WATER-SUPPLY.—By Horace B. Woodward. Cloth, small octavo. 250 pages. Ill. London: Edward Arnold. Price 7s. 6d. For sale by *The Mining Magazine*.

This is the third of the new series of handbooks published by Edward Arnold under the general editorship of J. E. Marr, dealing with the economic aspects of geology. The other two were on 'Coal' by Walcot Gibson and on 'Ore Deposits' by H. H. Thomas and D. A. MacAlister. The application of geology to civil engineering problems no less than to ore deposits has never received in England the attention from practical engineers that it deserves. For many years William Whitaker was the only geologist making a speciality of water supply. Thirty years ago Professor Boyd-Dawkins startled civil engineers by saying that the route of a railway or a tunnel should never be decided without consulting a geologist, but he converted at least one of the railway magnates. His speciality was rather to avoid water than to find it. The author of the present book has become identified with water supply and was also for some time the assistant director of the Geological Survey of England and Wales. In his preface the author refers appreciatively to the detailed researches undertaken in America on rain, rivers, and circulation of underground water, showing that public bodies have done more for the furtherance of knowledge in this subject in America than elsewhere.

The book discusses rainfall, its dispersal on the surface and underground, rivers and underground channels, springs, general geological considerations of strata and detailed accounts of the water-bearing strata in England and Wales, prospecting for water, sources of water-supply in frozen and arid regions, the quality of water, mineral waters, etc. As the author has gained his experience in England the book naturally deals largely with supplies here, and references to other countries are scant though based on good authority.

He describes the divining rod and the various opinions upon it expressed by scientific men and others, but he does not quote Ray Lankester, whose explanation fits best to my own experience. It has always seemed to me that the twitching of the muscles of the arms is due solely to the tiredness caused by holding the arms in an unaccustomed position. This is a perfectly good physiological explanation that fits all cases. E. W.

PRACTICAL DATA FOR THE CYANIDE PLANT.—By Herbert A. Megraw. Leather covers, pocket size, 96 pages. Ill. New York: The McGraw-Hill Publishing Co. Price 8s. 6d. For sale by *The Mining Magazine*.

This book is easiest described as being similar in intention and scope to Adams's 'Hints on Amalgamation.' It is intended for the use of the men in daily charge of cyanide plants, and treats of the construction and uses of tube-mills, agitators, presses, and other machines and apparatus, also the nature of the solutions employed and calculations thereon, and preliminary experiments on ores. It contains a large number of useful tables. It must be confessed that many of the illustrations are quite useless and give the casual observer a poor opinion of the book. The blame is probably not to be given to the author but to the publishers, who in their desire to liven up the book by pictures have put in any sort of worn-out cut. Mr. Megraw realizes that the book is not yet in the form most suitable and handy for the cyanide man. We hope that he and others will continue to collect data and give detailed instructions how to operate, for a practical book on the working of the cyanide process is still to be written.

A MANUAL FOR ASSAYERS AND CHEMISTS. — By W. H. Seamon. Cloth octavo, 260 pages. New York: John Wiley & Sons; London: Chapman & Hall. Price 10s. 6d. For sale by *The Mining Magazine*.

This book contains much original matter, some of which has been published by the author in technical journals but none has ever appeared in book form before. The author has had considerable experience in teaching assaying and analysis at the New Mexico and the Missouri Schools of Mines and has also been engaged in practical metallurgical work in the Southern and Western States of America and in Mexico. The methods described are adapted to the requirements of the college graduate when first thrown on his own resources in the field. Each chapter is made additionally useful by notes of the uses of each metal and ore, and of the method of valuing the ores.

INTRODUCTION TO THE STUDY OF METALLURGY.—By Sir W. C. Roberts-Austen. Sixth edition, revised and enlarged, by F. W. Harbord. Cloth, octavo, 495 pages. Ill. London: Charles Griffin & Co. Price 18s. For sale by *The Mining Magazine*.

This book was originally published in 1890 and was the first of the celebrated series of mining and metallurgical books written by associates of the Royal School of Mines and published by Charles Griffin & Co. In a recent review of the new edition of Le Neve Foster's Mining, belonging to the same series, we mentioned that the reviser had considered it best to add little new matter. Mr. Harbord has endeavoured to follow on these lines and he admits that he felt bound to preserve the general scheme of the work and to make as few alterations as possible. However, the results of recent research and general metallurgical progress have made it necessary to rearrange many parts and to add much that is new.

Chapter I, dealing with the relation of metallurgy to chemistry has not been altered. In chapter 2, the table of physical constants has been revised and the chapter has been divided, the section relating to alloys being transferred to chapter 3. The chapter on thermal treatment of steel has been expanded by the inclusion of the heat treatment of various industrial alloys. The chapter on pyrometry has been practically re-written, and a new chapter on metallography replaces that on microstructure. Fuel now has a chapter to itself and types of coke-ovens and gas-producers are described. The chapter on furnaces has been re-cast, new types being introduced and old ones rejected; the electric furnace is also described. The bibliography at the end of each chapter has been kept up to date. Mr. Harbord gives credit in his preface to help received from William Gowland and C. O. Bannister. The work has been well done. It is only fair to Mr. Harbord to say that a revision is never as satisfactory as an entirely new book, and that a book on this subject by Mr. Harbord himself would be more acceptable.

TRANSACTIONS OF THE INSTITUTION OF MINING AND METALLURGY.—Vol. XIX. 630 pages. Ill. London: The Institution of Mining and Metallurgy. Cloth 25s.; paper 21s.

This volume contains a large number of important papers, abstracts of which have already appeared month by month in our pages. The period covered is the session 1909-10, the meetings being held monthly from September 1909 to May 1910. The papers are published in full together with the discussion, and the two form a valuable record of opinions and views. The most interesting papers have been: The Development of Heavy Gravitation Stamps, by W. A. Caldecott; Reverberatory Furnaces at Cananea, by L. D. Ricketts; Leaching Copper Dumps in the Ural, by A. L. Simon; Grading Analyses and their Application, by H. Stadler; A Standard Series of Screens for Laboratory Testing, by Theodore J. Hoover; and Standardization of English in Technical Literature, by T. A. Rickard.

MINES OF RHODESIA.—Edited by Owen Letcher. Cloth, small octavo, 460 pages. Johannesburg: *The South African Mining Journal*: London: G. Leighton Hare, Throgmorton House, Copthall Avenue. Price 12s.

This handbook of mining in Rhodesia is intended for miners and settlers. The title page says "Second Edition," though the introduction dated June 30 of this year refers to the "first issue of the Mines of Rhodesia." The book covers only Southern Rhodesia, and the districts to the north of the Zambesi will be added when a new edition is prepared. The first chapter gives a history of Rhodesia and describes general conditions; chapter 2 deals with the geology; chapter 3 gives the mining laws of Southern Rhodesia. The largest part of the book then follows, treating in detail the various mining districts. Subsequent chapters give information suitable for settlers, such as the method of acquiring land, facilities for education, agriculture generally, cattle regulations, game laws, native labour, and railway communications. The volume is accompanied with two elaborate maps which help in learning about the mines of the country.

COMPRESSED AIR: THEORY AND COMPUTATIONS.—By Elmo G. Harris. Cloth 8vo. 130 pages. New York: The McGraw-Hill Book Co. Price 6s. 6d. For sale by *The Mining Magazine*.

This book deals entirely with the mathematics of air compression and forms a useful companion to Peele's book on compressed-air plant for mines. The author is professor of civil engineering in the Missouri School of Mines. The book is by no means elementary and is intended rather for the college-bred engineer than the self-made mechanic. The first chapter covers the laws of compression, expansion, and thermodynamics, the second with methods of measuring the delivery of air, the third with friction in air pipes, the fourth with hydraulic air-compression, and the fifth with the return-air system and other applications. The sixth chapter describes the air-lift pump and the author makes a special study of it. He instances it as an example of a successful method at first condemned as contrary to the laws of physics. In fact, patents were refused by the United States patent office on this ground, the examiners alleging that for this reason it would not work in practice. Nevertheless it has proved an important addition to the resources of the engineer, for by its use a larger quantity of water can be got out of a small deep well or shaft than by any other means, and it is free from the drawbacks connected with other deep pumps. The remainder of the book gives examples of calculations and many useful diagrams and tables.

THE YUKON TERRITORY, ITS HISTORY AND RESOURCES.—Octavo, paper covers. 180 pages, with many illustrations and maps. Ottawa: The Government Printing Bureau.

This is a bulletin of 180 pages issued by direction of the Minister of the Interior, Ottawa. It is a revised edition of the pamphlet issued in 1907, but has been enlarged and improved. The chapter on Mining has been entirely re-written and is thoroughly up-to-date. Illustrations are numerous and excellent. The statistical information is valuable. As a general description of the industrial development of the Yukon Territory this publication is interesting and as a concise account of the exceptional conditions affecting mining near the Arctic Circle it has technical value, especially to those interested in Siberia and other regions of extreme cold.

GEOLOGY OF THE MONARCH MINING DISTRICT, COLORADO.—Cloth, 78 pages, with maps and illustrations By R. D. Crawford. Boulder, Colorado: The Colorado Geological Survey.

This district was a notable silver producer from 1880 to 1893, the Madonna being the leading mine, but it then suffered by the fall in the price of the metal. Within the past few years the demand for zinc ores and for basic fluxing ores has revived interest. The old mine-owners did no forward development, so that there is a chance for miners who adopt modern methods.

CURRENT LITERATURE

Mount Bischoff. — In the *Mining Journal* for August 6, 13, and 20 there are articles on the Mount Bischoff tin mine, Tasmania, written by J. D. Millen, the manager, to whose ability is due the prolongation of the life of the mine.

Gas Plants at Mines.—In the *Mining Journal* for July 3, M. von Bernewitz contributes an article on the use of suction gas plants used at mines in Western Australia.

Mining Locomotives.—At the July meeting of the Transvaal Institute of Mechanical Engineers, Kenneth Austin read a paper entitled 'Mining Locomotives and Liquid Fuel, and their influence on the South African Labour Problem.' The author compares the cost of benzol locomotives used in Germany with that of hand-tramming on the Rand.

Oxygen in Silver.—The *Journal of the Society of Chemical Industry* for August 31 contains an article by F. G. Donnan and T. W. A. Shaw describing experiments investigating the absorption of oxygen by molten silver and the associated spitting during pouring.

Effect of Iron on the Solibility of Gold.—In *Metallurgical and Chemical Engineering* for September, J. M. Tippett, of the Portland mill, Colorado, describes experiments made to determine the effect of grinding between iron surfaces on the gold contained in an ore. He found that ore ground in this way was not amenable to cyanide extraction though the same ore ground between flints gave good results. He attributes the phenomenon to the iron polishing the surface of the gold. We would draw attention to the explanation given in our last issue that iron acts as a cyanicide.

Mining in Quebec.—The *Canadian Mining Journal* for September 1 gives a full abstract of T. C. Denis's report on the output and progress of mining in Quebec during 1909.

Dry Concentrator.—*Metallurgical and Chemical Engineering* for September describes the McKesson dry concentrator for use in connection with ores and gravels.

Mining at Pachuca.—In the *Bulletin* of the Mexican Institute of Mining and Metallurgy for June there is an article by E. Girault, manager, on the San Rafael mine, at Pachuca, Mexico, dealing with the geology and method of mining; the cyanide plant was described in a previous bulletin.

Mining in Gogebic Range. — The *Mining World* (Chicago) for September 10 contains a paper by P. S. Williams, reprinted from the transactions of the Lake Superior Mining Institute, on mining methods at the Gogebic iron mines in Minnesota. The system adopted is that of top-slicing, and it differs in detail from the similar system at Mesabi.

German Mining School.—At the September meeting of the Institution of Mining Engineers, Henry Louis read a paper describing the Mining School at Bochum, Westfalia.

Utilizing Exhaust Steam for Power.—At the September meeting of the Institution of Mining Engineers, J. Burns read a paper on the utilization of exhaust steam, and he gave many instances in connection with engines having intermittent loads such as rolling mills, winding engines, etc.

Tin Smelting in Germany. — In *Metallurgie* for September 8, H. Schuphaus gives an account of the method of smelting tin concentrates imported from Bolivia, chiefly in connection with the practice adopted for roasting the concentrates and the preparation of the smelting charge.

High Explosives. — The *South African Mining Journal* is publishing a series of articles on high explosives by W. R. Quinan, of the De Beers company, who recently died during a visit to Australia.

Trail Smelter. — In *Mines and Minerals* for September, J. M. Turnbull describes the Trail smelter and lead refinery belonging to the Consolidated Mining and Smelting Co. of Canada. The smelter was first erected in 1896; the Canadian Pacific Railway bought it in 1898, and sold it to the present company in 1906. The smelter treats the copper-gold ores of the Centre Star and Snowshoe mines and silver-lead ore from the St. Eugene mine.

Zinc-Dust Precipitation.—In the *Engineering and Mining Journal* for September 3, A. B. Parsons describes the method of adding zinc-dust to cyanide solutions for the Merrill precipitation presses, used at the Goldfield Consolidated and the Montana-Tonopah, Nevada.

Converter Practice.—In the *Engineering and Mining Journal* for September 3, R. R. Moore gives an outline of converter practice for the treatment of copper mattes, starting from the earliest days of Hollway and tracing the gradual improvements.

Settling Fume.—In the *Engineering and Mining Journal* for September 10, G. B. Lee describes experiments in connection with the settling of very fine dust from smelting furnaces, undertaken by him at the Copper Queen smelting works, Arizona.

Comparisons of Crushing Machines.—In the *Engineering and Mining Journal*, H. L. Wollenberg gives a comparison of the relative capacities of gyratory and jaw crushers in proportion to the power used.

Electrolytic Determination of Copper.—R. C. Benner in the *Engineering and Mining Journal* for September 10 describes a rapid electrolytic method of determining copper.

Slime Settlement.—In the *Monthly Journal* of the Chamber of Mines of Western Australia for July, R. E. Huntley describes a slime settler or dewaterer used at the Brown Hill Consols, Kalgoorlie.

Records of Costs.—In the *Mining World* (Chicago) for September 3, S. F. Shaw, general manager, gives an account of the method of recording costs at the Montezuma mine, Costa Rica.

Continuous Treatment in Pachuca Vats.—In the *Mexican Mining Journal* for August, A. Grothe gives a history of the proposition made by J. L. Mennell and carried out by M. H. Kuryla for the continuous instead of individual charging and discharge of Pachuca vats.

Testing Cyanide Solutions.—In the *Mexican Mining Journal* for August, J. E. Clennell describes the method of testing cyanide solutions used at the Creston, Colorado, plant.

Willis's Calciner.—The *Iron and Coal Trades Review* for September 23 describes a new calcining furnace for the treatment of carbonate iron ores invented by W. J. Willis.

Estimation of Zinc. — The *Australian Mining Standard* for August 24 contains a description by F. E. Connah, abstracted from the Proceedings of the Royal Society of Queensland, of a process for estimation of zinc in copper ores.

Analysis at Copper Queen.—The *Mining and Scientific Press* for July 30 describes the chemical laboratory and methods employed at the Copper Queen smelter, Douglas, Arizona.

Mining at Cananea.—In the *Mining and Scientific Press* for August 20, Courtenay De Kalb describes the top-slicing methods of mining at the Cananea copper mine, Mexico.

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Scientia non habet inimicum nisi ignorantem.

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REVIEW OF MINING

INTRODUCTORY.—Five new mining issues were made in October, absorbing an aggregate capital of £445,300, as against three issues, requiring £555,000, in September. The rise in the Bank rate to 5% was expected, for it is usual at this season and merely protects the London money market. The further decline in Consols to 78¾, the lowest since 1847, is an event the significance of which is readily misinterpreted. It is variously imputed to the rumour of a big Navy loan, to Continental liquidation, to Turkish borrowing, to the Charing Cross Bank failure, and to Liberal legislation. As a matter of fact Consols have declined ever since the Trustee Act widened the scope of those who are responsible for making safe investments and they have dropped steadily as new avenues for remunerative speculation have been offered in other countries. The fall in Consols reflects no national financial insecurity and need suggest no monetary crisis. We are as free from the one as from the other.

Such apparently is the general opinion, for the stock markets generally have exhibited some cheerfulness. New York, Paris, and Berlin have all evinced greater animation. Monetary conditions are excellent. In the mining departments the business has improved, despite the usual quota of untoward incidents.

The Board of Trade returns continue most satisfactory. Our imports and exports in October were worth £103,700,000, or £9,200,000 more than in the corresponding month last year. This year promises to break all records in British trade.

TRANSVAAL.—The statistics for September indicate a slight increase in profit as compared to any immediate preceding month of 30 days, owing mainly to the larger quantity of ore crushed. The extraordinary uniformity in the average result is a consequence of the enormous scale of the operations, which are such as to obscure any variations due to individual mines. The figures for the first nine months are given herewith:

MONTH.	Tons	Yield per ton	Costs per ton	Profit per ton	Total profit
1910		s. d.	s. d.	s. d.	£
January	1,754,140	27 7	17 0	10 7	924,275
February	1,614,730	28 5	17 6	10 10	874,746
March	1,767,059	27 6	17 1	10 4	913,759
April	1,763,104	28 1	17 6	10 7	927,244
May	1,785,821	28 3	17 6	10 9	958,347
June	1,766,737	28 1	17 9	10 5	921,136
July	1,814,686	28 1	17 8	10 4	937,456
August	1,834,105	28 3	17 8	10 6	961,304
September	1,835,647	28 3	17 11	10 4	942,330

Near the end of the month a shiver of apprehension was caused by weakness in East Rand Proprietary shares. All sorts of rumours were circulated. Authoritative cablegrams, followed by buying of shares, tended to restore confidence, but left the cause of disquiet as much of a mystery as ever. Apparently the trouble was in London, not at Johannesburg, and was due to a bear raid, cleverly concocted so as to be on the eve of a holiday interval. Some adverse influence was imputed to the theory, promulgaled by Messrs. Bleloch and Sawyer, that the East Rand banket formation is not a part of the Main Reef series; as if the intrinsic value of a big group of fully developed mines could be affected by a geological label. Local gossip is to the effect that the Cason ground is proving poorer than anticipated, but this is refuted by the detailed, but rather belated statement, issued on November 7. Another rumour was that the entire group of mines had been re-sampled, with the result that the average had been lowered to 6 dwt. per ton. This, of course, is a weird nightmare, and unthinkable, for it would argue criminal incompetence in the management. We mention the yarn only to dismiss it. A third, and much more likely tale, connects the fall in quotations with realizations effected by Mr. Abe Bailey,

who, it is stated, is selling out his Rand holdings with a view to transferring his energies wholly to Rhodesia.

The closure of the Van Dyk, Vogel Deep, and Cloverfield mines naturally disappointed the shareholders interested, and may have started selling at Paris. Later the rumours that development work on Sundays would be prohibited were used by those who wanted to depress the market, but this matter presumably was settled by the report of the Mining Regulations Commission issued in August.

Announcement is made that the City Deep mill is to commence crushing in December, the delay being caused by the loss of a steamer carrying some of the electrical machinery required by the Rand Mines Power Supply Co., which thus became unable to deliver compressed air until February next. Meanwhile the scarcity of labour, the organization of a complete force, and the preparations for economical extraction all justified the postponement. The mine itself continues to open up satisfactorily and the prospects are deemed excellent.

Among the favourable factors is the New Modderfontein report. This indicates expansion of the most healthy type. Tonnage, revenue, and profit are all bigger. For the year ending June 30, 1910, the profit was £279,865 on a gross yield of £695,410, extracted from 523,950 tons of ore. The reserve is stated to be 2,581,744 tons, averaging 7·1 dwt. per ton, as against 1,564,434 tons and 6 dwt. in the previous year. The working expenses are 15s. 10d. as compared to 19s. 9d. a year earlier, but the profit per ton was less owing chiefly to a shortage of labour during several months. Other interesting details will be found elsewhere in this issue of the Magazine. The information given by the New Modderfontein company is explicit and intelligible; for instance, it is frankly explained that the increase in average grade "is due to the discovery of some extremely rich ore on the seventh level, No. 12 shaft, and it should be pointed out that it is hardly likely that this standard can be maintained indefinitely." However, it is satisfactory to note also that "without these rich blocks the ore reserves have practically the same value as last year."

RHODESIA.—The latest statistical information, namely, for September, shows a further decrease in the gold output. For the month the yield was 42,499 oz., valued at £178,950, as compared to £191,523 in August and £213,249 in the corresponding month of 1909. In fact, the output is the lowest since April 1907. The number of productive mines was 152, or 37 less than in August. The Gaika, Giant, Globe & Phœnix, and Jumbo show slight increases, but the Willoughby, Surprise, East Gwanda, and Penhalonga did not do as well as usual. Several mills have become idle on the transfer of mines to new companies, created by large consolidations, which will shortly resume production on a bigger scale. Thus the position is not as bad as it looks, although the delay is becoming irritating to anxious shareholders, for it has depressed the share market for many months. With the complete resumption of crushing operations at the Globe & Phœnix an increased production is assured. Unless the unexpected happens, the Rhodesian gold output should now increase steadily for some time to come.

The Shamva mines, covering the agglomerate deposit in the Abercorn district, have been boomed by statements concerning the enormous tonnage of low-grade ore already proved. It is said that 26,000,000 tons, yielding a profit of from 10 to 12 shillings per ton, is available. It is also rumoured that two firms of jobbers have acquired Shamva shares on favourable terms and are now engaged in a profitable campaign. As against this gossip is the information cabled by Mr. H. A. Piper, the company's consulting engineer, who states that on the No. 1 adit level the orebody is 120 ft. wide for 750 ft. long, averaging 4·2 dwt. per ton.

Including the ore proved above an upper prospect level, the reserve is given at 963,000 tons of 4·79 dwt. ore. A thorough sampling with a 5-stamp mill will commence in December. It is obvious that another big mine has been added to the productive resources of Rhodesia.

WEST AFRICA.—In this case, as in that of Rhodesia, the statistical story is not cheerful. The gold output in West Africa in September was 11,497 oz., valued at £47,746, as compared to 13,921 oz. in August and 18,125 oz. in the corresponding period of 1909. Last year the total yield was 235,972 oz., but this year it is not likely to reach 200,000. Four mining companies are responsible for the entire output, the lead being taken by the Ashanti Goldfields, which produced 6109 oz. from 8551 tons, as compared to 7409 oz. from 9310 tons in August. In this big region also the output is curtailed pending development and reorganization, which are proceeding slowly. The Prestea mines await the completion of the railway, from Tarkwa, of which we give a couple of illustrations. On August 27 the opening of the Accra-Akwapim railway was celebrated. Progress is being made, but with a slowness that is hardly understood by those unfamiliar with the natural difficulties of the West Coast. We discuss the subject fully on another page.

The appointment of Mr. James J. Thorburn to be Governor of the Gold Coast Colony is announced, the post having become vacant by the death of Sir John Rodger. The new Governor comes from Southern Nigeria, where he was Lieutenant Governor, therefore he is familiar with the character of the work to be done.

The Abosso and the Abbontiakoon both sent good reports. In the former the developments between the 5th and 8th levels, inclusive, show 4 to 5 ft. of 8 to 19 dwt. ore. In the Abbontiakoon the reserve on September 30 is estimated at 295,363 tons of 12·6 dwt. ore, as against 196,312 tons of 12·9 dwt. ore on December 31 last. The mill has been idle since June 1909. It is proposed to replace the ball-mills by stamps, preliminary to a resumption of crushing. At the Prestea Block A, a further postponement of milling has been caused by the non-completion of the Government bridge across the Ancobra river and the consequent delay in the receipt of machinery.

Two new companies, the Bisichi and the Gel, have been formed to exploit the tin deposits of Nigeria, and the first dividend to be credited to this region has been declared by the Naraguta company. A large number of engineers have now been sent by various companies to the Niger country and we cannot doubt that useful results will be shortly forthcoming. We also note that over thirty different companies operating in Northern Nigeria were represented at a meeting held in London on October 20 to organize concerted action with a view to improving the facilities of transport. A resolution was passed urging the Colonial Office to expedite the construction of a railway to the Bauchi tin region. Several committees were appointed and a successful effort was made to secure unity of purpose.

AUSTRALASIA.—The most vivid event is the flotation of the Bullfinch Proprietary, preceded and followed by the flamboyant statements concerning its richness. We refer to the subject elsewhere. The revival of the Yilgarn district, formerly one of the most disappointing in Western Australia, has excited attention locally and in London. It is a cheerful episode. We hope it may continue to be so. We learn that other issues are pending, and it will be remarkable if the success of the Bullfinch does not fill the air with the tomtits of the promoter. It is stated on good authority that so far the only ground in the locality known to be rich is comprised within the Bullfinch property, therefore the public will do well to be chary of buying shares in subsidiary or 'extension' companies. Remember the Londonderry.

THE NEW RAILWAY FROM TARKWA TO PRESTEA, WEST AFRICA. Governor's train at the Ancobra River.

RAILWAY UNDER CONSTRUCTION.

The Bullfinch discovery and the impending flight of goldfinches, chaffinches, etc., from Western Australia, gives additional interest to the interim report of the Oroya Exploration Co. This company has an option on the Corinthian North and other leases on the Yilgarn district. Four shafts have been sunk to 100 ft. and cross-cuts have found from 8 to 20 ft. of 12 dwt. ore. We made reference to these developments in our September issue.

Another good item of news comes from the Sons of Gwalia, where the cross-cut at 1470 ft. has cut the west lode at 198 ft. showing 10 ft. of 25 dwt. ore.

The talk of imposing an export duty on zinc products from Broken Hill, with a view to compelling treatment at Australian smelters, is likely to interest many in London. We refer elsewhere to the zinc industry, now so prosperous at Broken Hill. The revival of interest in mining at Bendigo, by reason of promising discoveries on a side 'line of reef' or subordinate lode, is welcome news. Another satisfactory recent development is the good showing on the bottom level of the Tasmania mine, at Beaconsfield, in Tasmania, where the drift at 1370 ft. has already been advanced for 140 ft. in ore 7 to 10 ft. wide averaging 1½ oz. per ton. This is both timely and encouraging, for it will be remembered that the Tasmania Gold Mining Co. underwent reconstruction lately, in order to reduce the nominal capital and obtain fresh funds. The original working capital was £180,000, all of which was consumed in equipment, and in the succeeding seven years all the gold extracted, exceeding £600,000, has been put back into the mine, being absorbed in the heavy expenditure necessitated by an excessive inflow of water and by other unexpected difficulties. In September it was decided to reconstruct, and to levy an assessment that would yield an additional £62,500 of working capital. This, owing to the good news from the mine, has been over-subscribed. The showing at 1370 ft. is the best in the last three hundred feet of sinking and the lode at this, the deepest, level is said to resemble that which proved so profitable in the upper workings, before the transfer to the English company. The mine yields 3½ to 6 million gallons of water per 24 hours—a figure that suggests the difficulty under which deeper exploration has been conducted. However, mines become less wet, and eventually dry, in depth. Therefore if the ore persists, as now appears probable, the Tasmania ought to see better days.

CANADA.—It will be noted that our Toronto correspondent refers to Porcupine. We also publish an article by Mr. A. L. Simon, who has just returned from this district in Northern Ontario. Various companies are said to have made purchases. Among these is one controlled by members of the U. S. Steel Corporation, including Messrs. Ambrose Monell, Cory, and Capt. De Lamar. These gentlemen have acquired the control of the Dome, a property showing big outcrops, which have been tested by diamond drilling to a depth of 400 ft., with results supposed to justify a capitalization of $2,500,000. It is also stated that the Consolidated Gold Fields of South Africa, through Mr. Louis Webb, brother of Mr. H. H. Webb, has acquired the two 'veteran' claims owned by Connell & Rea. This is a prospect 20 ft. deep, showing a couple of feet of rich ore, for about 40 feet.

UNITED STATES.—Our Salt Lake correspondent gives some news from the copper mines in Nevada. As regards the precious metals, the Tonopah district is lively. The output of the leading 7 mines aggregates 36,000 tons per month. Just now the Belmont mine, owned by the Nevada Belmont Development Co., is attracting the most interest, owing to the discovery of a lode east of the big fault at a depth of 1100 ft. The monthly production is 6000 tons of milling ore averaging $35 per ton, and 1000 tons of smelting ore assaying

$70 per ton. All the local mills seem to be doing good work. At the Tonopah, Tonopah Extension, and Montana Tonopah mills the extraction is said to reach 92 and 95%. At Goldfield, the Consolidated mine has rich ore in the bottom workings and production continues on a large scale. In September the mill treated 24,095 tons, averaging $31·42 per ton, giving a gross value of $751,164, of which 93% was extracted. In addition 123 tons of ore was shipped to the smelters for a yield of 36·21 oz. per ton, so that the total output was $843,224, of which $563,966 was profit.

Developments in South-eastern Alaska are excellent. The deep adit to the Alaska-Treasure mine, on Douglas island, has cut an intermediate lode, said to average $4 for a width of 50 ft. The adit, now 2700 ft. long, will be advanced so as to cut the main Treasure lode, which is 1000 ft. farther. A large stamp-mill will be erected if all goes well.

MEXICO.—One of the most famous mines in Mexico is the Rosario at Guadalupe y Calvo, in Chihuahua, now owned by the West Mexican Mines Ltd. Additional interest is created by the report of Mr. J. S. MacArthur, the originator of modern cyanidation. The mine has also been examined by Messrs. Philip Argall and F. L. Sizer, both men of acknowledged repute. Indeed the Rosario has undergone many inspections during the last decade. Big dumps and a large tonnage of low-grade ore exist, and it remains to be seen whether, as is now indicated, the cyanide process will effect a better extraction of gold and silver than was possible by amalgamation.

Esperanza shares dropped violently in the latter part of October owing to the failure of a speculator who held 20,000 shares on a weak bull account. The accident was precipitated by the decreased profits for August and September. As far as we can learn the condition of the mine has undergone no serious change, but technical difficulties in the mill together with a drop in the grade of the ore have temporarily affected the output. The October figures are expected to show an improvement.

SIBERIA.—The Orsk Goldfields has issued a circular explaining that the commencement of dredging is postponed until the summer of 1912 because a part of the machinery was lost in a shipwreck, but the stacker-scow is expected to be at work next June and extract £12,000 worth of gold monthly, one half of which should be profit. Meanwhile exploratory work, under the direction of Mr. C. W. Purington, has resulted in further discoveries of rich gravel. Mr. D'Arcy Weatherbe is now resident manager.

From NORWAY we have information of reviving hope in iron mining after a time of deep discouragement and depression. Operations started some time ago in two new districts, Salangen and Varanger, have resulted in what is said to be an industrial success. It seems that the great iron deposits can be worked successfully when they contain magnetite. As regards Dunderland, the scene of Mr. Edison's gigantic but unprofitable experiments, a treatment has been adopted which is supposed to be effectual at least for the hematite. Apart from the iron the best prospects for making money are in connection with the water-power resources of the country. For a while the Government, in a fit of Norway-for-the-Norwegians, forbad the acquisition of these powers by alien capitalists, but more recently regulations to this effect have been revoked or so modified that the foreigner is again welcomed.

News from the copper mines presents nothing of special interest. Sulitelma gradually increases its output. Ancient Röros is still active though not without anxiety and misgiving as to its future. Birtavarra shows progress and is supposed henceforth to take rank as one of the productive mines of Norway. It is reported that gravel rich in gold has been found in the Gossejok river, a tributary of the Tana.

ARGENTINA is one of the countries in which mining has tried to run before it could walk;

in other words, big things have been attempted recklessly before small things had been done carefully. We learn that the Cerro Blanco mines in the province of San Juan are to be resuscitated by an undertaking backed by Mr. Robert Methuen and directed locally by Mr. Juan Campbell. The building of a railroad to within five miles of the mines and the finding of water by digging through a porphyry cap have removed the two chief obstacles to systematic operation. The ore consists of iron pyrite containing copper, up to 2%, and gold, up to 20 oz. per ton. The veins are from 3 to 10 ft. wide. Vigorous prospecting is under way and a mill is to be erected to test the ore.

Another Argentine enterprise lately prominent is the Famatina Development Corporation, the management of which has been changed lately. Hooper, Speak & Feilding are now the general managers. Prospects of profitable operation are said to be bright. The attempt to smelt pyritically failed by reason of an excess of alumina in the copper ore, thus necessitating more heat than was supplied by the combustion of the pyrite. Now roasting is to precede smelting with coke. Plenty of ore appears to be available.

DREDGING.—The season in the Seward Peninsula, that is, the region tributary to Nome, Alaska, has closed successfully. A dozen dredges were in operation last year and the number was doubled this year. Not all of them were operated profitably, for in several cases the machinery was applied to ground that had not been properly tested and in one or two cases the dredges are being frankly used for prospecting, preparatory to building a number of machines. The Pioneer Mining Co. is operating a small dredge of the Risdon type on Ophir creek and has cleaned up $800 per day while digging 1200 cu. yd. per day. Operating expenses are about $300 per day. Other and larger dredges in this region extract 20 to 40 cents per yard and make a good profit on this yield, but new ventures would be well advised not to start on an expected gross yield of less than 50 cents per cubic yard, for the season is only 120 to 130 days and the maintenance of machinery during the long winter is costly, owing to frost and flood.

COPPER.—The restriction of output announced early in October by the Rio Tinto company had an excellent effect on the metal market, by suggesting that the leading producers were in agreement to curtail production. The mid-month statistics showed a further reduction in visible supplies of copper. At the end of October the total supplies of copper available in England and France were stated, by Henry R. Merton & Co., to be 88,422 tons as against 93,961 at the end of September and 113,455 tons at the end of February. Stocks are given as 77,872 tons and deliveries at 45,000 tons. James Lewis and Sons point out that the reduction in stocks in England may have a misleading influence for much of the copper exported from America now goes to Germany and Holland.

The figures for October published by the American Copper Producers' Association show an increased output and a decreased delivery as compared with the somewhat abnormal figures for September, but the deliveries were still ahead of the production, so that the stocks continue to decrease. The output for the month was 56,459 tons as compared with 53,357 tons in September. The domestic deliveries were 30,274 tons as compared with 28,795 tons, and the export 30,441 tons as compared with 33,529 tons, making the total deliveries 60,715 tons as compared with 62,324 tons. The stocks on November 1 were 62,170 tons as against 66,426 tons on October 1 and 75,393 tons on September 1. Early in November there was talk of a French syndicate that was to do something for copper. *Absit omen!* Memories of the Secretan fiasco are still too fresh. Copper has suffered enough from French and American attempts to reverse the laws of supply and demand.

EDITORIAL

ANNOUNCEMENT is made of the selection of Mr. H. Livingstone Sulman as president of the Institution of Mining and Metallurgy for the ensuing year, in succession to Mr. Edgar Taylor, who retires after occupying the chair most worthily and efficiently for two years. Thus the representative of mining gives place to the exponent of metallurgy. Mr. Sulman deserves the honour, for, apart from his high professional status, he has given ungrudgingly of his time and energies to the welfare of the Institution. We note also that the annual dinner of the Institution of Mining and Metallurgy will be held in the Grand Hall of the Connaught Rooms on Friday evening, December 9. A musical programme has been arranged.

WITH deep regret we hear of the death of Thomas Hewitson, formerly manager of the Great Boulder Perseverance mine, and earlier at Clunes, in Victoria. He died on September 13 at Dunedin, New Zealand, having reached the age of 76. He represented the best type of the old school, capable and progressive, but honourable above everything. In the boom days of 1897 and 1898 he never lost his head nor allowed his hand to stray toward other people's pockets. Many of the younger men have felt his good influence and in their behalf, as well as for happy personal memories, we place this wreath upon his grave.

ON October 26 the Mining and Metallurgical Club held its first annual dinner, followed by a smoking concert. Mr. Sydney Farrar presided; to him, to the Secretary, Mr. Charles McDermid, and to Mr. H. L. Sulman, of the entertainment committee, are due the cordial thanks of members for a most agreeable affair, well organized and well conducted. Of better augury for the club and more important than even this delightful inaugural function was the suggestion, made by the President, that it was proposed to start a luncheon room in the City. The mention of the idea elicited immediate applause. We have good reason to believe that such a step would be cordially welcomed and would do much to solidify the foundations of the club. More need not be said at this time.

THE Spassky meeting was a pleasant affair and was signalized by the declaration of the first dividend. We note with particular pleasure that the manager, Mr. H. C. Woolmer, and his staff received a vote of thanks for their services. The Russian members of the staff were not forgotten, and if they were not mentioned by name, with the English and American technical men, we may suppose that this detailed distinction was only omitted because the director, who brought forward the subject in a graceful speech, was not as familiar with Russian as he is with other languages. This practice of recognizing the faithful service of those in charge of mines and smelters is well worthy of imitation. We are glad to see it becoming less infrequent.

WE refer elsewhere to slipshod writing in a publication that should set a good example. If further warning be needed, it is to be found in a description of Porcupine prepared by a writer quoted with approval by a London financial paper. We read that "the ore in situ" is sufficient to enable the writer to give "a certificate of permanency" to "the Porcupine camp." He found "quartz bodies predicating tonnage" and a "payability in degree as yet somewhat undetermined." As a man inclined to take one or two drinks too

many may be warned by the sight of a drunkard reeling in the gutter, so the gentlemen of the Institution may well say that but for the grace of God there goes one of themselves.

THE OPENING of the Union Parliament of South Africa is an event deeply significant to men of liberal mind. It sets the seal on an act of national magnanimity unexampled in history. Peace indeed hath her victories no less renowned than war. To have conquered the Boers may, or may not, have been something of which to be proud, but to have won their goodwill and to have received them into the Empire so soon after a bitter war is cause for exultation. It is one of the miracles of statesmanship. For the result we should honour three men above all others: First, Cecil Rhodes, who died complaining that there was so much to do and so little done, unaware that he had builded better than he knew; second, Henry Campbell-Bannerman, the statesman who seized a golden opportunity to translate liberal ideas into generous fulfilment; and third, Louis Botha, the lion-hearted enemy who turned a physical defeat into a moral victory. It remains for British and Dutch alike to justify such leadership, and to unite unreservedly in the effort to create a self-governing nation worthy of traditions so noble. We believe that it will be done.

SUGGESTIONS are being made in the financial Press that shareholders in mining companies should form an association to protect their interests, particularly in the way of receiving prompt news from the mines. It is claimed that certain firms obtain information before the main body of the shareholders, who get belated and rather cryptic reports long after the insiders have had their innings on the Stock Exchange. We shall be glad to see such an association formed and we hope that extreme care will be exercised in the choice of an executive board, the members of which will obtain information before those shareholders who do not belong to the association and conceivably before the directors of some of the companies themselves. The early bird will be on another tree and it remains to be seen whether he will twitter more discreetly. Protective associations will not solve the difficulty; it will be necessary to form a detective bureau to watch the protective association, and it will be equally necessary to keep an eye on the detectives, and so on. Somebody must be trusted; why not begin at the beginning and impress the existing authorities with a proper recognition of their obligations. Directors are trustees; the owners of a mine are the shareholders. That should be the motto emblazoned in every board-room. Then we shall hear less of unpleasant episodes, leaks of information, and the like.

AMONG recent issues is the Jicaro Gold Estates. The prospectus includes a report, in excellent form, by Mr. E. W. J. Edwards; who is well qualified to advise in such matters. The consulting engineer is Mr. James A. Gilmour, who is also thoroughly well qualified. In these respects the venture starts under good auspices. And yet it is open to criticism: the engineer reporting on the mine is "interested in the property on behalf of" the vendor, as the prospectus frankly states. Moreover, the consulting engineer does not report on the mine, as far as is made apparent. We have not the slightest reason for doubting the good faith of either of the engineers mentioned nor the accuracy of the appraisal made by one of them, but we do lay stress on the irregularity of procedure. It is the company's consulting engineer that should be valuing the mine for the shareholders, who are his clients, and not Mr. Edwards, who is frankly interested in the business with the vendor. No particular harm may have been done in this case, but it is quite certain that it is a procedure calcu-

lated to jeopardize the interests of the shareholders and directors constituting the company.

After the above comment was written the prospectus of the Gel Tin Lode & Alluvial Co. appeared in the daily Press. From this we infer that Mr. H. W. Laws is in the employ of the Niger Company, which is the vendor of the property to the new company that now advertises its enterprise. We have no criticism to make of the report made by Mr. Laws, but we deem it proper to point out that the only report that is quoted in the prospectus was prepared by an engineer identified with the vendor interest. This is unsound business, and places the engineer himself in a false position.

HAWTHORNE Silver and Iron Mines is a company the shares of which are offered as a "Canadian investment." The company is incorporated under the laws of Delaware, the general office is at New York, and the promoters are Americans. The issue may be said to represent the least pleasing form of the American invasion. The gentleman chiefly responsible is Mr. Julian Hawthorne, who gives to the enterprise a name that was associated with literature until it became the signature to financial pamphleteering of an unpleasantly flamboyant character. The members of the directorate, the advisory board, and the engineering staff are not known to us in connection with mining affairs, although such connection probably exists. A capitalization of £3,000,000 requires better endorsement and more justification than now appears.

WE NOTE a curiously misleading letter in the *Financial News* of October 22, in which the dividends paid by mining companies in different regions is shown to average 10%, with, for example, an average of 20% in the case of West African mines and 29½% in that of Indian mines. The simple-minded reader will overlook the casual mention of the fact that the calculations are based on nominal capital, not market valuation. Emphasis is laid on "the high yield shown." All of which is apt to prove confusing, seeing that the purchaser of shares buys them on quotations, which, in the case of dividend-paying mines, are usually at a high premium. It is by the purchase of shares in rich mines at inflated prices that most of the money is lost rather than by the small gambling in wild-cats. Hence we find reason to question the complacent statement that "possessing Skinner's *Manual* and the *Financial News* daily, the investor's equipment for dealing with mines is as near complete as it is possible to be." No manual and no journal can serve as the complete guide to the ignorant investor. Better than books are men; it is better to go for advice to mining engineers and experienced financiers than to editors or journalists. The latter have useful work to do, but the leading of the lamb between the bulls and the bears is not one of them.

A CORRESPONDENT signing himself 'Superficies' has sent an interesting contribution to the discussion on the 'square fathom,' but he does not divulge his identity in the orthodox manner, by enclosing his card; therefore, of course, we do not publish his letter. This is in accord with prevalent custom, for while an editor will publish a letter over a *nom de guerre* he will refuse to do so unless he himself is given the true name of the writer. But in professional and technical matters we go further and deprecate even the use of pseudonyms, for opinions concerning such subjects are ineffective when uttered by a fictitious voice; it is the personality backing the statement that gives it penetrative power. Professional men are usually willing to vouch for their assertions by signing their own names, and their readers assuredly are entitled to such protection as comes from knowing to whom they are giving attention. Anonymity is objectionable in technical literature. In just a

few cases it is merely a ruse for giving a surreptitious stab to a rival.

ONCE UPON A TIME there was an 'engineer,' who was sent to examine a gravel mine in Alaska. He was what is called a 'tenderfoot' in America and a 'new chum' in Australia. He asked for samples of the ore. They emptied a 'poke,' which is a small leather sack. From this reticule there issued gold in particles resembling rolled oats or wheat flakes. Then they spread some nuggets before him. The nuggets looked like young potatoes. He pawed them in a meditative fashion for a minute or two, and then asked: "Is the ore free milling?" It is related that the owner of the claim fainted on the spot and lingers in a sanatorium to this day. The fate of the 'engineer' is surmised; when he reached his proper destination he asked the gentlemanly attendant in charge whether the climate was equally hot all the year round.

OLD MINES die hard. We happened recently to see a list of the quotations of mines listed on the Denver Stock Exchange and we noted with pleasure that the companies whose shares stood well today are the same as those honourably conspicuous ten years ago, namely, the Portland, Golden Cycle, Elkton, El Paso, Mary McKinney, and Vindicator. No new names are prominent. Stratton's Independence is the one notable exception, but it, as is well known, was the victim of an Early Victorian kind of finance. Cripple Creek has proved longer lived than some critics prophesied and it has afforded opportunity for the application of great technical skill. Telluride ores are now being milled for $2 per ton, as compared to a cost of $7 per ton a decade ago. Incidentally, we note that the Denver Exchange refuses to list as 'mines' any property that has not produced at least $12,000 net during the preceding year; all others are labelled as 'prospects.' This is a rough and ready method of differentiation based on the idea that "by their fruits you shall know them." It does indicate the good intentions of the Exchange and its desire to protect the public.

SAMPLING of ore underground has been more fully discussed than the similar series of operations at surface, in the mill and smelter, yet the correct performance of this test is essential to economic success. We take pleasure in publishing an article on the subject by Mr. Lewis T. Wright, the general manager for the Mountain Copper Co., a well known English enterprise in California. He analyses the theories underlying the usual methods, and elucidates the effect of chance in vitiating the systems in vogue. The difficulty of impartial mixing, which is the basis of all sampling, is emphasized in respect of the heterogeneous material produced by a mine, and the ascertainment of the minimum weight of sample assuring a correct result is elucidated by means of a series of experiments. He makes it clear that the usual methods fail to pay sufficient regard to the inexpugnable fact that, in gold ores particularly, the richest portion is apt to be the fine. Therefore a true average is unattainable in a mixture consisting of particles varying greatly in size. The same idea, from a different standpoint, was expressed recently by Mr. L. D. Ricketts, the manager for the Greene-Cananea Copper Co., in the *Engineering and Mining Journal*. That experienced metallurgist insists properly on the fact that groove-sampling, grab samples, and churn-drilling are all vitiated by the undue proportion of fine brittle mineral that is broken. This is likely to be a special source of error in sampling disseminated copper deposits, the richness of which is due to the presence of chalcocite. Allowance must be made for this constant error; in low-grade ores, with a narrow margin of profit, it may be fatal.

The American Elections.

Wall Street appreciates the result of the American elections held on November 9. At first quotations rose in a burst of enthusiasm; as soon as the facts were appreciated, the market collapsed. Mr. Roosevelt's nominees have been defeated in the East but victorious in the West. The perspective of politics in the United States has been upset violently. New conditions have been created, and for the first time in many years the Democratic party is in the ascendant. The position is too complex for easy analysis, but as we view it from a distance the one significant fact is that the American people have protested successfully against the domination of the strategic wealth of the country as expressed by the Republican caucus. In the turmoil Mr. Roosevelt has been overthrown. The result was rendered probable as soon as he undertook to endorse the Payne tariff and defended a protective policy that has been at the bottom of the political and industrial corruption of the United States. As a statesman he saw that predatory finance had laid a heavy hand on the natural resources and the vital activities of his country, as a politician he winked at the basic cause; he was either illogical or insincere. He has been disciplined. But nothing can erase the debt that is owing to him for his campaign against wrong doing and wrong thinking; it is one of the ironies of the situation that he it was who gave the Democrats the very ammunition with which they won a victory over himself and his fellow Republicans. Apparently the high tariff and the high cost of living were the chief factors in the election results, and with the protest against both was mingled an undisguised reaction against the graft that has honeycombed the Republican party during its long tenure of power. That power is broken and with the event comes a confident hope that representative government in America is destined to undergo further and more fruitful development.

Bullfinch.

This is the name of a mine 22 miles from Southern Cross, also known as Yilgarn, in Western Australia. Reference to recent satisfactory developments was made in these columns two months ago. On October 26 Mr. Frank Wilson, the Premier of Western Australia, spoke of these new discoveries in extravagant terms, saying that "even Kalgoorlie and the Golden Mile sink into insignificance when one listens to reports regarding this [Bullfinch] property, which bids fair to eclipse anything discovered in the history of the State." This, and more like it, was cabled to London and promptly appeared in the financial Press. On November 2 it was duly announced that the Bullfinch mine would form the basis for a company, the prospectus of which would be issued the next day. Advertisements of the Bullfinch Proprietary Ltd. appeared on November 3. The sequence of events may properly provoke remark and the inference naturally made may be unfair to Mr. Wilson. Knowing the Golden Mile when at its best, knowing that Yilgarn is one of the oldest mining districts in Western Australia, and one of the most disappointing, we regret that the Premier should have employed language so likely to mislead the public and to be used as ammunition by company promoters. It is delightful to hear that recent discoveries at Yilgarn are satisfactory and that an extremely valuable mine has been opened up, but the exaggerations of the Premier should rather cause well informed people to discount the facts than to stimulate their interest in this part of Western Australia. Mr. Wilson ought to know that as a Premier his statements are liable to be given a value that they do not possess, for the fact that he is Prime Minister does not imply a knowledge of mining. The opinion of a Premier on a mine is worth no more than that of an Archbishop. The only opinion on a mine that is worth anything is that of a mining engineer and preferably that of one who

is not participating in the profits of promotion. In the advertisement issued "for public information only" the Premier is quoted, as was to have been expected; then follow extracts from reports by Mr. D. L. Doolette, the worthy discoverer of the mine and a part owner; and finally an opinion by Mr. V. F. Shallcross, "who acquired an interest in the property shortly after its discovery." The valuation of the Bullfinch by the two engineers might be conclusive if these gentlemen were disinterested experts, but they are not. On the other hand we are informed that Messrs. Richard Hamilton, of the Great Boulder, and John A. Agnew, of Bewick, Moreing & Co., both examined the Bullfinch mine. Why are their reports not quoted? It is obvious that their estimates, if made as part of an independent investigation, would afford excellent guidance to the public if "public information" be the object of advertising particulars concerning the finding of rich ore. Already the shares have been lifted to 150% premium, indicating a valuation of £1,250,000 for a mine said to show a profit of £250,000. The public will do well to be cautious. More money is lost in good mines that are overvalued than in holes of no value.

West African Mining.

Mining in West Africa is suffering from a *malaise*. It is not an acute illness, with definite symptoms; it does not threaten dissolution; but it is none the less serious. For years the patient has exhibited an inexplicable langour and lack of response to treatment, varied by brief outbreaks of spurious activity under the stimulus of a market boom, only to be followed by a further period of lifeless depression. Such a complaint does not kill, but sooner or later it results in chronic inanition. The facts are clear enough. It is now eleven years since one at least of the great Rand houses took a hand in the exploitation of the Taquah banket and this example was so largely followed that today there is hardly a South African group without an interest in West Africa. It has been proved that the mineral resources of the country are rich and extensive. The Taquah banket is comparable in point of regularity and gold content to some of the best portions of the Rand. The Prestea is a remarkably persistent quartz lode, and to the north the Ashanti goldfield has disclosed large deposits of good ore. All this, however, only accentuates the melancholy character of the actual record of progress. On the banket only two companies have paid a dividend and their working costs up to last June were 33s. 3d. and 47s. 8d., respectively, as against an average for the whole of the Witwatersrand last year of 17s. 1d. The Prestea is not producing. The gold output of the entire region is less today than it was twelve months ago. Facts such as these are disquieting to shareholders, and unless within the next twelve months some radical change is effected, the British public will decline once and for all to finance West African mining. Nevertheless, we make bold to say that today, for the first time in the history of the industry, it is possible to feel an optimism none the less strong for the chastening of experience.

It has been assumed too readily that the basic trouble in West Africa may be summed up in two words: malarial fever. That is far from being the case. The evil is more complex and less easily curable. It would be absurd to minimize the malarial scourge. The indirect losses, due to decreased vitality, in preventing the best engineering talent from seeking a career in West Africa, and in frequent changes of staff, are difficult to assess in terms of pennyweights, but they are considerable. On the other hand, they are commonly exaggerated. Malaria is unmistakably decreasing and a good deal of the loss in efficiency now attributed to fever is certainly due to quite other causes. In a paper written by Sir Rubert Boyce, who was sent by the

Colonial Office to investigate an outbreak of fever on the West Coast, the astonishing theory is developed that a gigantic error in diagnosis has been made and that what has hitherto been regarded as malaria is in fact yellow fever. However that may be, Sir Rubert appeared not to have the least doubt that the history of some of the West Indian islands could be repeated and the disease reduced to a minimum. This conclusion is in a large measure confirmed by the progress now being made. At the Oceana meeting Mr. David Q. Henriques quoted the Government statistics, which show that in 1902 the death-rate among the employees at the various mines on the Gold Coast was at the rate of 23·13 per thousand, and that in the year 1908 the rate had declined to 14·49 per thousand. This includes deaths from accidents and other causes not connected with the climate. In the light of these figures we may conclude that the malarial scourge is already scotched and is in a fair way to be killed. The one thing necessary to secure this desirable result is concerted action on the part of all the mines *and* the Colonial Government. It is very little use for one company to cleanse the area it controls if the agent of infection, the mosquito, is allowed to flourish on an adjacent property. Hitherto concerted action has been lacking and it is precisely because there now seems a fair chance of securing it that a modified optimism is permissible. It would serve no purpose at this time of day to enquire into the causes that have impeded unity of action. The precarious position of many mines, the lack of knowledge on the part of directors in London, the jealousies of men on the spot, have all been factors; and he would be a sanguine observer who considered that even today these hindrances have entirely disappeared. But a new spirit has manifested itself within the last six or nine months. The old West African Chamber of Mines, a moribund body that contented itself with discharging insignificant functions in a perfunctory spirit, has been remodelled on the basis of the Witwatersrand Chamber. It now represents virtually every element engaged in mining in the Gold Coast Colony, and its executive is singularly strong. In future all negotiations between the Colonial Office and the companies will be conducted through the Chamber, and there is every reason to hope that the necessarily delicate relationships which had been allowed to drift to the point of armed neutrality will now become normal and reciprocally helpful.

In another direction also the indications of common action on the part of the mining companies are hopeful. We have said that the difficulties of mining in West Africa are not confined to fever. Not the least has been bad food. No fresh meat is available on the West Coast, and the frozen article when landed in open surf-boats under a tropical sun is apt to become unappetizing and even unwholesome. To the shareholders in England this may seem a minor point; to the men who have to eat the meat it looms large. Directly and indirectly the economic result is profound; therefore it is extremely satisfactory to know that the mining companies are determined to attend to this matter, so that their employees may be as well fed as in any other mining region. If this be done there is little doubt that a great deal of actual illness will disappear, a large leakage of industrial energy will be stopped, and white labour generally will become more efficient.

There remains native labour, the most difficult question of all. Here again common action has been secured at last. A Native Labour Association on the lines of the Transvaal Association is in process of formation and Mr. Wolfe Murray, who has had a long experience of a similar problem in South Africa, has just returned from the West Coast after a lengthy tour, which he made on behalf of the mining companies. All this is to the good; but it

would be a mistake to assume that because the mines have at last come into line the end is in sight. Another factor of enormous importance is the Colonial Office. It is impossible at present to predicate its attitude with any confidence. The seriousness of the existing situation does not admit of argument. According to the figures available, between 15,000 and 16,000 natives are employed on the mines, 12,000 being employed in the Gold Coast Colony and the remainder in Ashanti. It is estimated that the existing companies will require a further supply of from 15,000 to 20,000 during the next three or four years. Estimates of this kind are often misleading, as Rand experience shows; but there can be no question that even today the shortage is real and that if the mining industry is to maintain itself, and still more if it is to expand, the labour supply must be supplemented in quantity and made more efficient in quality. The problem is acute and the possible alternatives are few. The obvious solution of importing Asiatic labour is impracticable. It is not even contemplated. Apart from the attitude of the local officials, who would be strongly hostile, it may be taken as certain that no British government, assuredly no Liberal government, would nowadays run the political risk involved in such an experiment. There remains importation from other West African regions. Here the evidence as to an available surplus is conflicting. It may, however, be regarded as probable that a certain supply of good, but somewhat unruly, labour might be obtainable from Lagos, and a further amount from Nigeria, where the requirements of the tin mines must not be overlooked; and a considerable quantity could be drawn from the Northern Territories. The chances are that if these sources were tapped under proper conditions the supply would be sufficient. But importation, which entails a considerable capital expenditure, cannot be contemplated until it is officially sanctioned, and there must also be some certainty that the labour thus obtained will be regular and efficient. This is the crux of the problem. At present native labour on the West Coast is both irregular and inefficient. It has been the practice to build native villages close to the mines on the chance that the natives would live there and become available as labourers. No contracts for specific periods were made, for no means existed for enforcing such contracts. The inevitable consequence is that the natives work for a few days, weeks, or months, as the case may be, and then seek other employment or indulge in a prolonged rest. Under these conditions disorganization tends to become chronic and anything like a satisfactory standard is impossible. It is no exaggeration to say that the efficiency of the shifting army of 12,000 employed in the Gold Coast Colony is not equal to 75% of the same number of native workers in the Transvaal, and it is difficult to see how a parity is attainable until some continuity of employment can be secured. In other words, the companies should be enabled to make labour contracts for reasonable periods, with legal sanction to enforce them. The difficulties are admittedly considerable, but not insuperable, given good-will on the part of Downing Street. In the Transvaal the problem has been solved by a 'pass' law under which every native has to carry upon his person what is in effect an identification ticket and produce it to an official when called upon to do so. Such a regulation is a necessary corollary of labour contracts. It is commonly believed by the British public that gold-mining companies herd their natives in something resembling a prison, where they remain until their contracts of service have expired. This idea is wholly unjust. A native is virtually free to come and go pretty much as he chooses, and no one suggests that any restraint should be put upon him in West Africa; but it is obvious that if a contract for labour is to have any value, there must be

some ready method of identification in case the labourer takes it into his head to leave the mine. Logically therefore there is no alternative to some form of pass law. It cannot be avoided. The difficulties, of course, in the way of introducing such a system are far greater on the Gold Coast than in South Africa, where the natives are, with but few exceptions, manual labourers and illiterate. The West African native is sometimes a lawyer, or a doctor, often a fairly prosperous tradesman, and it is not surprising if in these circumstances the Colonial Office and the local authorities look askance at any proposal that implies an official recognition of inferiority. In view of the urgency of the problem we would suggest that the difficulty might be met by applying the law only to proclaimed mining areas and equally to white and blacks within these areas. Possibly the European or educated native might be disposed to resent such a system, but a little cool reflection would convince him that there was no substantial ground for resentment. There is nothing necessarily dishonouring in being required to carry some badge of identification. In Europe many millions of people do so without notable inconvenience or loss of respect. On the West Coast every man in a mining area should realize that the essential interests of the industry on which he depends are bound up with the system, and the higher his intelligence the more readily should he understand its necessity. In practice, as regards respectable white people, it would mean nothing. It will not be the first case in which the inhabitants of a mining region have voluntarily made sacrifices in the common interest. At Kimberley, for example, it is still the law that a man in possession of a rough and uncut diamond shall be held guilty unless he can prove innocent possession, and whites and blacks have alike submitted to a system which reverses the wholesome presumption of the common law, and which may conceivably be productive of hideous injustice, simply because the common interest demands it. The case in West Africa is precisely similar. In some way or another this labour question must be met if the mining industry, on which the whole economic future of the Colony depends, is to maintain its position. It is the one outstanding question that threatens prosperity. Both in London and on the West Coast the mining companies have organized so as to pursue a common policy, in the interest alike of the industry and the employees. But all this will be wasted unless ample and efficient labour is forthcoming. It is difficult to imagine that Downing Street, despite its occasional tendency to obscure plain questions with metaphysical subleties, will long obstruct any well considered measures after it has been demonstrated that they are necessary to the industry upon which depends the development of West Africa.

Disraeli and Mining.

Thanks to the publication of Mr. William F. Monypenny's first volume of the biography, Disraeli is just now in receipt of literary interest such as he himself would have desired. The connection with mining may not be obvious, but it exists: When only 20 years of age he published a pamphlet entitled 'An Enquiry into the Plans, Progress, and Policy of the American Mining Companies.' This pamphlet, which was anonymous, was Disraeli's first effort as an author. At that time—1825—the tide of speculation was high and several mining companies were being freely used as counters for gambling transactions on a large scale. One of these was the Anglo-Mexican Mining Association, which had been promoted by friends of Disraeli himself. The latter undertook "to afford the public accurate data for forming an opinion as to the nature of these undertakings" with a view to the possibility of legislative interference, which just then was advocated by Lord Eldon, the Chancellor, and other authori-

tative persons alarmed by the evidence of speculative fever. Like Danton, Disraeli appears to have taken for his motto "*L'audace, toujours, l'audace.*" And in this first literary adventure he lived fully up to it, for even his biographer allows that the dulness of his financial subject "is relieved by occasional passages of picturesque impudence." Knowing nothing about mining, a tyro in finance, and a youth of no experience in business, Disraeli yet ventured to discourse learnedly of mining methods and arrived at the conclusion that "the general promise" of these mining companies "is performed" satisfactorily, and that "the value of the shares of the different companies will be found to be relative to the progress which they have made in mining, and to the former reputation of the mines which belong to them." He took the ground that the development of mining in America is comparable to the manufacturing interest in England and dwells on "the benefits to both countries that must follow from the development" of the former. He deprecates the attempt to control "the spirit of commercial enterprise" and asks "the lawgivers to pause before they decide, and to enquire before they legislate, and not to be induced by frivolous tales and unfounded fears to restrain or prevent the agency of undertakings which are not the least conspicuous parts of a system on which mainly depends the wealth, the power, and the glory of our country."

Our readers will be curious to know which were the mines that prompted Disraeli's first effort as an author. In 1822 Spanish rule ended and Iturbide became Emperor of Mexico. His brief empire was soon followed by a Republic, which was represented at the Court of St. James by Don Lucas Alaman, an enthusiastic exponent of Mexican mining. He succeeded in exciting the interest of English speculators in the United Mexican Mining Association and the Anglo-Mexican Mining Company. These companies had acquired several of the biggest of the old mines near Guanajuato, on the Veta Madre, Sierra, and La Luz lode systems. This was in 1823. In 1824 the Real del Monte mines, formerly owned by the Count of Regla, were sold to an English company, whose reckless extravagance is still mentioned with gusto in every Mexican guide-book. The £100 shares rose to £16,000 apiece almost before a start had been made and enormous sums were spent in ponderous machinery that had to be hauled across country from Vera Cruz. This company went into liquidation in 1848, after extracting $16,000,000 in silver and spending $20,000,000. In 1850 the Real del Monte mines were acquired by a Mexican company, which retained ownership until 1906 when a Boston corporation purchased the control and started operations now highly successful. It was only in 1905 that the San Cayetano mine, the last bit of property retained by the United Mexican Mines Association, was transferred to a new American company. This marked the end of the concerns for which the author of 'Vivian Grey' lifted his versatile pen.

Untechnical Writing.

The learned gentlemen responsible for the editing of the proceedings of the Institution of Mining and Metallurgy must be suffering from a reaction against the recent campaign for precision in technical writing. In Bulletin No. 73 a Brazilian mine is the subject of a valuable paper; this is disfigured by many errors. We confine our criticisms to two pages only of the bulletin. In the first place we note a veritable orgy of unnecessary plurals; thus the foot-wall is said to consist of "talcose schists" and the quartz is separated from the tourmaline by layers of "quartzites." Are there several varieties of 'talcose schist' and many kinds of 'quartzite' or have the foliations and the layers, respectively, induced a false notion of multiplicity? The reader is told much that is interesting concerning "itabirites"; why is this in the plural? 'Itabiryte,' as a micaceous iron schist, is sufficiently

well known. The paper is also bespattered with queer local terms, such as *canga* and *guia*, which are out of place even when intelligible to the few, and are merely gibberish to the many to whom these words are without significance. Why "quartziferous" instead of 'quartzose,' and why "*ultra-acidulated* granitic apophysis"? The italics, which are ours, serve to emphasize an example of pretentious ineptitude. Even "mica quartzitic schists" is not happy; for 'mica-quartz schist' is more explanatory, and 'quartzose mica-schist' might serve. Almost anything, however, is better than *guia* and *canga*. Measurements are given in terms of knife-blades, inches, and metres. "Iron pyrites" is diversified with "pyrite." On the same page we find "garnets" included in a list of minerals; why is this in the plural, while "pyrite," "calcite," and "graphite" are in the singular; is it that we are to have in mind a number of crystals of 'garnet'? That is the suggestion, if any, but it is a wrong one, for the author is referring to a constituent mineral without regard to its form. The average dip is "20° from the horizontal," as if dip were ever measured from the vertical. "The direction of the strike varies considerably"; so does the deviation from correct usage, for the author or editor, or both of them, appears to forget that 'strike' expresses a "direction" in points of the compass. We move to cut out "direction of the." "Why is "faults" printed with double quotation marks? Is it a new or unfamiliar term? We believe not. Even "horses" is harnessed with excessive quotation marks. The "cementation of disintegrated itabirites" is more impressive than explanatory. *Canga* may "occasionally carry gold," but it rarely conveys meaning. If the formation is of Archæan origin, it would be well to state the grounds for laying stress upon the geological period to which it is allocated. Several gold lodes, such as the Homestake, are in pre-Cambrian rock; but pre-Cambrian is not necessarily Archæan. Finally the author is allowed by the editor to speak of "this strata," a suggestion of illiteracy that should bring a blush to those responsible for this technical publication. Other errors might be cited, simply by turning to more than two pages of the bulletin in question, but it would be unkind to belabour the point, which is obvious enough: the Institution of Mining and Metallurgy ought to refrain from a blundering carelessness that would shame the Mining Association of Kalamazoo or the Metallurgical Institute of Wandiligong.

Iron Resources.

The International Geological Congress, which was in Session at Stockholm during August, proved most successful and terminated with a series of highly interesting excursions to different parts of the Scandinavian peninsula. Among the publications prepared for the use of those in attendance was an elaborate volume on the reserves of iron ore known to exist in various countries. This elicited a valuable discussion in which several authoritative speakers took part. Among them was Mr. James F. Kemp, the professor of geology in Columbia University. We publish his contribution on another page, and it will be welcomed not only as affording suggestive data but as being imbued with the engineering spirit so necessary to give useful application to the facts ascertained by the geologist. The discussion of which it forms a part took place in the Hall of the Nobles, a famous old chamber decorated with a thousand escutcheons, expressive of Swedish history from early antiquity. The setting for a geological discussion was unusual and was calculated to impress men habituated to a keen appreciation of the value of time as a factor of change. Herr Karl Schmeisser, the German Oberbergamtsdirektor, presided; the Swedish Prime Minister opened the proceedings with a few felicitous remarks, and then a paper by Prof.

L. De Launay was read, followed by the Spanish delegate, Señor Ramon Adan de Yarza. After him Prof. F. Beyschlag, the Director of the Prussian Geological Survey, submitted some ill-timed criticisms that threatened to create an unpleasant situation, but, fortunately, he was followed by Mr. Kemp, who is possessed of the saving sense of humour, which Attic salt no less than oil is well adapted to calming troubled waters. After he had spoken, there were calls for Mr. Henry Louis, but the Durham professor, so closely associated with the exploitation of iron ore in Norway, was absent—possibly at Dunderland. The entire discussion will shortly be published in German and all that we can find space to give is a significant fragment. We have abbreviated the title, the full text being : "On the means of finding the necessary supply of ore for the iron industry of the future."

Mr. Kemp's paper discusses the value of iron deposits from the commercial point of view, more particularly with regard to a future supply, and it served to remind his fellow geologists that deposits of iron ore and of coal must always be considered concurrently. A deposit of iron ore is of no value if there is no supply of fuel. In our Précis last month we published abstracts of articles, one on the iron industry of Mexico, and the other on the iron ore resources of France, and these two afford excellent object lessons. France has immense iron ore beds, which are not so favourably situated for coal as those of its neighbours, Germany and Luxembourg. In Mexico are some of the largest deposits as yet discovered, but, coal being scarce and of poor quality, they have not been exploited extensively. For centuries they were worked on a limited scale, using charcoal as fuel. Unfortunately the conservation of resources was neglected and the forests were depleted without care for the future. In this regard the Russians can point a lesson, for the iron smelters conserve their forests, and in fact the science of forestry plays as important a part in the iron industry as metallurgy. However, charcoal cannot meet the world's demand for iron. It makes a more reliable and more durable material, but not in quantities large enough nor at a price sufficiently low. A hard coke, low in ash, and operations on a large scale are of more importance than high quality. Moreover, many other considerations in iron and steel metallurgy make for economy and the extended use of low-grade ore. For instance, it is only recently that economy of fuel has received due attention. Much fuel is now saved by eliminating re-heating, but undoubtedly the utilization of blast-furnace gases and coke-oven gases is the most important step in advance. For many years the Scottish blast-furnaces have been saving the gaseous and liquid by-products. The inducement here was great, for the furnaces use a hard bituminous coal in its raw state and the gases are of great value. The German metallurgists have led the way in these questions of waste prevention. England has followed not far behind. America has led in the reduction of cost by means of increased scale of operations, but has been backward in the saving of by-products.

Another point emphasized by Mr. Kemp was mentioned by us a year ago, that is, the idea prevalent in America and even in some quarters in this country that the iron ore resources of Great Britain are approaching exhaustion. All sorts of exaggerated pictures are drawn of the frantic efforts of British ironmasters to obtain other sources of supply. It is true that the South Wales iron ores are not now worked, but the mines in Scotland, Cumberland, Yorkshire, and the Midland counties will continue to yield for many years. The Midland iron ores are usually overlooked, though they are increasing in importance. They are in the oolite beds and extend from the north of Lincolnshire southward through Northamptonshire. They are at the surface

and are easily worked, so that their low tenour is compensated by low cost. In round figures two-thirds of the ore treated in Great Britain is domestic and the other third imported. It is true that the older mines in the north of Spain are nearing exhaustion, but we hear of other deposits farther inland that will probably take their place. As Mr. Kemp says, this subject is one that deserves a whole volume to itself. His article contains an excellent synopsis and we recommend our readers to study it carefully.

Leakage of Information.

The Broomassie, Bantjes, Kleinfontein, and other companies have been involved recently in episodes arising out of the alleged belated publication of important news from the mine. This has drawn attention to a matter of vital interest. In some of these cases the directors may not be free from blame, but in most of them the board is as much the victim of irregularities as the shareholders themselves, if not more so, for whatever financial injury the shareholder may deem himself to suffer it is certain that the director suffers the additional hurt of a questioning of his integrity as a trustee. In several cases that integrity has been unjustifiably doubted and the case has become obscured by wanton accusations. Unfortunately, the average Britisher's dislike to making a fuss in public prevents him from rising in his place at a meeting and calling for an investigation. Hence the trouble is usually started by some person of irresponsible character or a seeker after notoriety whose antics burlesque the cause of fair play in mining matters. Such filibusters get scanty support and usually succeed only in creating a scene, for the annual meeting of shareholders is apt to be attended by mere onlookers and press-men, who help to make a brave show of hands when an adverse motion is put, only to be negatived by the verdict of the subsequent poll, when it is usually found that the directors have an overwhelming number of proxies. Public meetings are ineffective in checking irregularities connected with the transmission of news from mines and only throw ridicule on a protest that may be fully warranted if properly made. For this reason we note with interest that recently a number of members of the Stock Exchange petitioned the London committees of the Bantjes and Kleinfontein companies "to investigate the evident possession by Johannesburg people of prior information about the position of the mine as proved by the market operations for some time previous to the publication of official news." The petitioners lay stress on the fact that the confidence of the public is weakened by such methods and that an exposure of them is necessary to restore trust in the high character of mining operations in the Transvaal. To this petition the directors of the two companies promptly replied by cablegram from Johannesburg, stating that the leakage of information was most regrettable but beyond their control, that they transmitted news as soon as it was ripe and gave it concurrently to shareholders on the spot and in London, and that it is impossible to anticipate rumours or to be ready to deny them before they have done their deadly work. All of which is true, but scarcely satisfactory as a reply to the protest. It leaves matters much as they were. At the bottom of the trouble is the participation in share speculation by members of the staff, and even consulting engineers. In the cases mentioned the consulting engineers are above reproach, but it is not so always, and the knowledge of this sinister fact tends to lower the code of those in a confidential position. It should be a rule that no member of the staff of a company should trade in the shares of his own, or of a neighbouring, company. At least, it might be understood that any purchase or sale of shares should be made through the company's own office, so that dealings would be

done in plain daylight. Companies would do well to enforce abstention from share-dealing by their employees and the latter would gain by attending strictly to business and by keeping away from the stockbroker's office. For one man who makes money by gambling, even on 'certainties,' ten come to grief, financially and morally. More professional men have been ruined by share speculation than by drink, it is deadlier to engineers than malaria, and it is not, by any means, an essential part of the business of mining. It is only incidental. Mining is the art of finding ore and of extracting it profitably.

Zinc at Broken Hill.

The present time is opportune for a short review of the conditions affecting the production of zinc at Broken Hill. It is not necessary to remind our readers that this industry forms an excellent example of the achievements of modern metallurgy. In the early days the complex argentiferous zinc-lead sulphides presented an apparently insuperable difficulty, and in spite of persistent investigations by the ablest experts on ore-dressing, the mining companies had to be content for many years with the production of a lead concentrate low in zinc, and an extraction of only one quarter of the total metallic contents, losing all the zinc-lead slime and the zinc tailing besides much of the silver. Millions of tons were accumulated in expectation of the discovery of some process able to treat such refuse. Flotation came to the rescue of the zinc tailing, enabling the sulphides to be separated from the heavy gangue, a separation that could not be done by gravity. The slime problem is not yet solved though several investigators are nearing the goal, progressing along independent lines of research.

The production of zinc concentrate by flotation processes at Broken Hill dates from 1903, when the Delprat process was started by the Broken Hill Proprietary, and the Minerals Separation process by the Sulphide Corporation. The Potter process, which was similar to Delprat's and is now incorporated with it, was tried by the Zinc Corporation, which was formed in 1903 to work the dumps belonging to the Block 10, British Broken Hill, and Broken Hill South Silver Mining companies. On its failure the Minerals Separation was tried, also unsuccessfully, and eventually the Corporation adopted the Elmore vacuum process. Subsequently the De Bavay company started and last year it was expanded into Amalgamated Zinc (De Bavay's). This company owns some of the dumps at the Broken Hill South; it is treating current tailing from North Broken Hill, and since March last the current tailing from Broken Hill South. As regards the Minerals Separation, this company is working dumps purchased from the Sulphide Corporation and is treating the current tailing of the Central mine on a royalty; these dumps are nearly exhausted but the current tailing amounts to 5000 tons per week. Of other mines at Broken Hill, the South Blocks is accumulating zinc tailing for future treatment, Block 14 is trying the Murex process, and Block 10 is adopting the Elmore plant for current tailing. Broken Hill South Silver sold some dump to the Zinc Corporation and some to Amalgamated Zinc (De Bavay's); until March last the current tailing was sold to the former and since then to the latter.

As regards the output of zinc concentrate, the total has risen from 57,602 tons in 1904 to 375,906 tons in 1909. The output for 1910 will probably be about 430,000, averaging 47% zinc, of which 120,000 tons will come from the Sulphide Corporation dump owned and worked by the Minerals Separation company, 70,000 tons from the Sulphide Corporation's current tailing, 87,500 tons will be produced by the Zinc Corporation, and 95,000 tons by Amalgamated Zinc (De Bavay's). As the Sulphide Corporation dump is near exhaustion

it is probable that the total output in future years will never again be as high. Another important point to remember is that the dump material still to be worked by the other companies is of lower grade than those portions already beneficiated, for in starting the various plants the better portions of the dumps were usually worked first. The average of the material now treated is 20% zinc, 6½% lead, and 10 oz. silver, but there must be many parts of the dumps where the zinc content is not greater than 12%. The average cost of treatment is 8s. per ton, which at present prices is the value of material assaying 11% zinc, 5% lead, and 7 oz. silver, so that much of the remaining dumps will yield only a small margin of profit. As regards the future price of zinc, we may assume that, as the Broken Hill output, which is the chief factor, will not increase, the present price will not recede. It is not certain how the European producers, some of whom have been obliged to suspend operations owing to their ore being of less value and regularity in content than the Broken Hill concentrate, will be affected in this slackening of the Australian supply. They may be able to re-enter the market and so prevent any great increase in the price of zinc.

In connection with the treatment of the zinc concentrate produced at Broken Hill, it is interesting to note that the buyers, who are almost entirely German firms, are not so desirous nowadays of having a minimum lead content. Formerly zinc sulphide ores or concentrates having a large percentage of lead were not in demand and were heavily penalized. Zinc metallurgy has undergone changes recently. For instance, the retorts are now made by the hydraulic press and are capable of withstanding reactions quite unsuitable to the old porous retort. Many improvements have also been made in the condensers, where the volatilized zinc is caught. The result of these various improvements has been that lead is not the bogey to the zinc distiller that it used to be. In the case of Broken Hill zinc concentrate the lead content has become a necessity to the zinc distiller, for it is of value in collecting the silver that is present in both zinc and lead sulphides. The new metallurgy provides for the collection of as much lead and silver in the zinc-retort residue as possible, and this residue instead of being thrown away is now treated in the lead furnace for the recovery of the lead and silver. The buyers of Broken Hill zinc concentrate during recent years have modified their terms of purchase as regards the lead content. They now penalize any zinc concentrate containing less than 5% lead, from 5 to 8% they pay nothing for the lead, and for anything above 8% they make an allowance. There is, however, no advantage to the seller to have any more than 5% lead, for every 1% zinc content is worth more than 1% lead, seeing that the prices of the metals favour the zinc. Another interesting point is that the payment for the silver in the zinc concentrate is at the rate of one shilling per ounce over a minimum which is generally about 5 oz., and in the lead concentrate the rate is 2s. per ounce of silver. It is clear that the terms of contract make it advantageous to the seller to get as much lead and silver into the lead concentrate as possible, as long as the lead in the zinc concentrate is not allowed to fall below 5%. This alteration in the terms of purchase receives the attention of sellers, who have to judge which is the most profitable way of treating the zinc tailing. Hitherto the zinc concentrate sold has been produced from the zinc tailing, which has the consistency of sand, and the zinc-lead slime ejected from the lead mills has been kept separate. This slime is high in lead and zinc, and contains much gangue, being similar in constitution to the ore. It is not amenable to concentration by tables and even if treated by a flotation process the concentrate derived from it would be unsuitable for either the lead smelter or the zinc distiller owing to

the lead and zinc contents being almost equal. We have recorded in our pages the efforts being made to render this slime concentrate amenable to flotation, by giving it a roast sufficient to sulphatize the blende and thus make it indifferent to the selective action of oil, but this process is not yet an important factor, and in the meantime the slime is accumulating. In view of this delay and also of the modified terms of purchase the Minerals Separation company has devoted much time to a consideration of an altered policy, and their engineers are in favour of treating the whole of the tailing and discard of the lead concentrators, without dividing it into zinc tailing, barren tailing, and slime. They consider that any slight loss due to the lower average zinc content will be more than compensated by the greatly increased output. The result of this 'total' treatment will be watched with interest. It is not possible for us to judge the correctness of the policy, for everything depends on the terms that the producers can arrange with the smelters. The Sulphide Corporation using the Minerals Separation process has the only mill in the world which takes a mixed lead-zinc ore and turns out a high grade lead concentrate and a high grade zinc concentrate in one continuous operation, and at the same time sends to the dump tailing and slime from which practically all the lead, zinc and silver have been extracted. This leads us to another question of vital importance to Broken Hill. At the present time the mines are absolutely at the mercy of the German smelters in the matter of zinc concentrate, just as years ago they were under the thumb of English and German buyers of lead ores. We are not surprised to hear that the mines, under the leadership of Mr. G. D. Delprat, manager of the Proprietary, are agitating for a protective export duty, to encourage the local smelting of the zinc concentrate.

The industry is unfortunately still under the shadow of litigation, which becomes more embittered and more complicated as time passes. More lawsuits are threatened. The action brought by the owners of the Elmore patents against the Minerals Separation company has passed through all its stages in England resulting favourably to Minerals Separation, and is shortly to be repeated in Australia, in the form of an action by the owners of the Australian Elmore patents against the Sulphide Corporation, which uses the Minerals Separation process. Another lawsuit is being started by the Potter Sulphide Ore Treatment company against the Sulphide Corporation, which will thus be attacked from both sides, the Elmore alleging infringement of the selective action of oil in a flowing pulp and the Potter company claiming the sole right to hot acid solutions. We also understand that the Minerals Separation company is commencing actions in England against the Zinc Corporation and in Australia against the Amalgamated Zinc (De Bavay's) company. The position is further mystified by the Zinc Corporation adopting the Minerals Separation process in the extension of plant now in process of erection, and by the Amalgamated Zinc having an option on the Potter process. We have often urged that all this litigation should cease and that the parties should be imbued by a spirit of enlightened self-interest. The door is still open for amicable settlement and we shall never believe that such a settlement is impossible. This suggestion, of course, is made on our own initiative, as unprejudiced observers. We appreciate the good work done and regret the loss of reward, for litigation is robbing the inventors of their proper profit. It is not too much to say that the success of the metallurgical processes that have given commercial value to the refuse at Broken Hill is one of the triumphs of technical science. At the present time the Broken Hill district supplies one-fifth of the total world's supply of zinc. All this has been accomplished in six years.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

TORONTO.

Porcupine.— Great activity prevails in this district, and large purchases of claims on British and American account are reported, giving promise of operations on a more extended scale in the near future. The latest announcement is that the Consolidated Gold Fields of South Africa has entered the field, and secured two claims covering 320 acres in the heart of the area, where development work has resulted in the discovery of a wide vein with a good showing of gold at 20 ft. Many British engineers and stock-brokers have recently visited the camp; Barnato Bros., of London, have two representatives looking after their interests; and numerous flotations in England are anticipated. Many of the mine owners are ordering machinery as installations are usually made in the winter when the roads are in a condition to render it possible to transport heavy loads. It is noteworthy that a considerably larger proportion of mining machinery than formerly is now Canadian made, the demand having stimulated that industry. There is an increasing demand for the Nissen stamp-mill, made by the Fairbanks-Morse Canadian Manufacturing Co., and their Toronto plant is being considerably enlarged. Several Porcupine, Cobalt, and Gowganda companies have secured stamps of this type.

Cobalt.—The share market continues to show an upward tendency stimulated by favourable reports from the mines and the appreciation in the price of silver, though nothing like a boom appears likely. The payment of dividends has been resumed by the Temiskaming and the Trethewey. The Temiskaming, which passed several dividends while perfecting its equipment, declared a quarterly dividend of 3% and the Trethewey made a payment of 10%. The Crown Reserve has issued a satisfactory report covering the first nine months of the year, showing receipts of $1,150,303, and net profits of $857,286, out of which $795,966 was paid in dividends. The total cash surplus on hand was $610,595. The Coniagas is raising and concentrating about 180 tons per day from the first and second levels and conducting active development on the third level. The Mount Royal Cobalt has discontinued work until next year and in the meantime will raise funds by putting 200,000 shares of the par value of $1 on the English market at 25 cents per share. The shaft of the Ophir is down 300 ft. and cross-cutting has been started at that level to cut the veins intersected at the 200 ft. level. The Little Nipissing recently made a good discovery in a drift on the 235-ft. level. The vein is now about 3 ft. wide with three rich pay-streaks of high-grade ore running through it. A drift is being run from a winze at the 285-ft. level to tap it at that depth. Kerr Lake's production has hardly kept pace with its dividend

Cobalt.

payments. The total income for the year ending August 31 was $1,542,194, and the expenses were $343,972, leaving a balance of $1,198,220, of which $1,050,000 was paid in dividends, leaving a surplus of $148,220. This is a decrease of $480,827 as compared with the previous year. The production of silver was 3,046,295 oz., the total cost of production being 13·27 cents per oz., and the mining cost 7·54 cents per ounce.

Cobalt.—There has latterly been a marked advance in the stock of the La Rose, owing to the highly satisfactory nature of the annual report for the year ending May 31 last, which shows a net product of silver of 3,170,028 oz., valued at $1,472,005. The cost of production, including extensive development, was 23·27 cents per oz., and the average selling price 52·26 cents per oz. During the year there was

paid in dividends $500,000, or 12% on capital, leaving a surplus of $473,740. The ore reserve of the La Rose is estimated to contain 5,544,000 oz.

Peat Fuel.—The experiment made by the Mines Department at Ottawa of placing on the market 500 tons of peat fuel manufactured at the Government experimental plant at Alfred, Ontario, has been highly successful. The peat was sold in a few days at $3·25 per ton, and large orders for a further supply are coming from consumers, who pronounce it a cheaper and more satisfactory fuel than coal.

Asbestos Amalgamated, a merger embracing a number of the asbestos companies in the province of Quebec, which was much criticized at the time it was effected, has passed its dividend, and the stock has suffered much depreciation in consequence. One effect has been to strengthen greatly the growing feeling against mergers, more particularly in reference to a project to amalgamate several Montreal power companies. It will probably result in the abandonment of the scheme, and it is hardly likely that any further extensive consolidations involving increased capitalizations will be put through for some time to come. The much discussed La Rose-Nipissing merger appears more remote than ever.

Coal.—Some excitement was caused early in the season by the announcement of the finding of extensive coal deposits along the Metagami river on the Hudson Bay slope of Northern Ontario, and a number of claims were taken up. An investigation made by Professor M. B. Baker of the Kingston School of Mines, at the instance of the Provincial Bureau of Mines, has disappointed these expectations. Professor Baker reports that the deposit is merely a poor grade of lignite, much broken and folded and non-continuous.

Work at the coal mines on the Brazeau river, in Alberta, has been discontinued. The Canadian Northern Railway is interested in the mines and the enterprise included the building of a line from Edmonton, but the plans for the construction of the road were not approved by the Railway Commission, so they were dropped. As all supplies for the mines had to be carried on pack-horses for over 100 miles, it was decided to suspend operations until the question of the route of the railway was settled.

Explosives.—The crying need for the legislation promised by the Canadian Department of Mines for the prevention of accidents from the use of explosives is further emphasized by the report of E. T. Corkill, Ontario Inspector of Mines, published in the report of the Provincial Bureau of Mines for 1910, just issued. The total number of serious accidents in mines during 1909 was 77, resulting in 49 fatalities and 53 injuries, the deaths being at the ratio of 4·66 per 1000 men employed. Figures covering the period 1900-1909 are given, showing that the accident rate had been steadily increasing since 1904 up to 1908, when a maximum death-rate of 5·11 per 1000 was reached. There were last year in all 24 fatalities caused by explosion or from gases, or 49% of the total fatalities. There is no country that publishes accurate statistics, says Mr. Corkill, where the accidents from explosives constitute so large a percentage of the total number.

Iron and Steel Bounties.—It is announced that the Canadian Government has definitely decided not to renew the iron and steel bounties which shortly expire, nor to grant any compensating increase in the duty on these manufactures. The bounties on pig iron, puddled bars, and steel ingots expire on December 31, and those on steel rods on July 1 next. This is a somewhat serious matter for the iron and steel interests. The bounties paid for the fiscal year ending March 31, 1909, the last for which the returns are available, amounted to $1,864,000. Of this $1,067,528 went to the Dominion Steel Corporation. President Plummer, of the Steel Corporation, states that their policy of expansion was dictated by the need of increasing the output and diminishing the costs of operation in order to compensate for the loss of the bounties. As a result of the abolition of the bounty on wire rods, they intend to produce other forms of finished steel. The corporation is increasing its productive capacity by one-third and preparing to make further extensions.

LIMA.

Copper.—The downward tendency in the price of copper is becoming a serious matter to some of the smaller producers. The unfortunate disaster at the Goyllarisquisga coal mines of the Cerro de Pasco Co., resulting in the death of 60 Indians and 20 injured, was the result of tamping the holes with fine coal instead of using the fire-clay furnished for the purpose by the company. This is the second accident of its kind during the year and was entirely due to the carelessness of the miners. The mine makes no gas but plenty of dust. One result of the disaster was to cause the Cerro de Pasco smelter to be idle from August 10 to September 5. Production now amounts to 700 tons per day, nearly the normal daily output. The smelting averages 3,500,000 lb.

copper per month; this is slightly below the high mark made in March, yet it indicates no real curtailment of output. The water-jacket furnaces are being renewed and minor changes are being made, but no substantial alteration of the plant is contemplated at present.

Vanadium.—A trial shipment of vanadiferous ash is shortly to be made from the Yauli district. The content is stated to vary from 30% to 35% vanadic oxide; if favourable terms can be made, regular shipments will result. The mines in the Minasragra district continue to make shipments regularly; the railroad that was planned has not as yet been commenced.

Aporoma.—The Franco-British-Peruvian Syndicate, which has taken up the Aporoma placer property, in the province of Sandia, has begun operations on the 45-mile trail, which is necessary for the transport of machinery and supplies. About £60,000 is in hand, which it has been estimated will be sufficient to put the property on a productive basis. The property covers 1277 acres and at least 49,400,000 cubic

yards of gravel are said to be available. It is expected that 150,000 cu. yd. will be handled per month. No doubt the favourable outcome of the above operations would stimulate the development of the large placer areas claimed to exist in that part of Peru. It has been rumoured that American interests have obtained a concession to dredge the Ocona river, which empties into the Pacific Ocean about 70 miles north of Mollendo; the river traverses a gold-bearing region.

The Andaray-Posco Co., formed two years ago (being the combination of the Andaray mine, which was at one time important, and a newer property, the Posco) after spending about £9000 in attempting to commence operations, have decided to change management and develop the mine. Considerable dissatisfaction on the part of the majority of the stockholders has brought about the change. The ore is valuable for gold, stated at 36·2 grammes per ton over widths varying from 0·18 to 1·10 metres. The ore occurs in lenticular shoots and 18,300 tons is stated to be available. The new milling plant will consist of two Lane mills, to reduce the ore to 40 mesh, for amalgamation, these mills having a combined stated capacity of 100 tons daily. The tailing will be cyanided. The property is situated in the province of Condesiujos, on a tributary of the Ocona river.

SAN FRANCISCO.

Mining Congress.—The thirteenth annual session of the American Mining Congress met from September 26 to October 1 inclusive at Los Angeles. This Congress, which attempts to bring together annually the representative men of all branches of mining, is gradually acquiring the confidence and support of the real leaders. At Los Angeles 1200 members and delegates were registered. As always, the majority were from the mining districts of the States adjacent to the point of meeting and that fact should be remembered in estimating the importance of the expression of opinion that the Congress annually makes through its resolutions. This year the interest centred, naturally, in the public-land policies of the United States and especially in conservation matters. Gifford Pinchot made an effective appeal from the standpoint of the conservationists, on the opening day, but, having then to leave for the meeting of the Irrigation Congress at Pueblo, Colorado, his followers were completely defeated in the real work of framing resolutions. As a result, while conservation was praised in many beautiful words, the anti-conservation policies were in the main endorsed. Specifically, the Congress declared against any form of leasing system as applied to public lands, and in favour of State, rather than Federal control. The leasing system, indeed, proved to have few advocates. It is rather striking that, whereas the system is so extensively and successfully applied in many other countries, and indeed throughout the Eastern and Middle parts of the United States, there is the densest of ignorance regarding it in the West. In consequence, and following from much deplorable friction with officers of the Forest Service and the Land Office, the miners of the West are almost a unit in opposing anything that savours of greater control by Federal Bureaus. It is, however, conceded that the land laws have been outgrown and must be modified in many important particulars. Probably the more far-seeing leaders are taking an

extreme conservative position in order to be in position to compromise effectively. Whether in the end, and with fuller information available, the miners will continue to oppose leasing, is not certain. The Administration at Washington is committed to leasing as regards at least coal, oil, and phosphate lands. Since the withdrawals of public land can be maintained by the President as long as he thinks worth while, and since manifestly the sentiment of the rest of the country will support the Administration in this particular, it is not unlikely that in the end some form of leasing will be adopted.

Oilfields.—Aside from the discussion of conservation, the Congress devoted sessions to special problems of the oilfields, to the improvement of the laws regarding mine inspection, to smelter and railway rates, and to similar matters. Informing and valuable reports were presented by the committees; especially those that have been studying mine accidents, standardization of electrical equipment, and Alaskan mining laws. These and other papers will appear in the proceedings and many of them are being published in the *Mining and Scientific Press* and other technical journals. The officers elected for the next year included John Dern, president; D. W. Brunton and S. W. Taylor, vice presidents; these E. R. Buckley, C. A. Barlow, A. G. Brownlee, and George Wingfield as directors. Los Angeles, as was to be expected, entertained the Mining Congress exceedingly well and there were many pleasant social events in the course of the week. Among others the meeting of the Mining and Metallurgical Society was especially enjoyable. It was notable in that there were present at one time D. W. Brunton, president of the American Institute of Mining Engineers, E. R. Buckley who held the same position in the American Mining Congress, and J. Parke Channing of the Mining and Metallurgical Society itself. Eastern and Western members of the Society were present in about equal numbers and an excellent spirit prevailed.

Tunnel driving.—The following day the same group left for a two days trip of inspection along the Los Angeles aqueduct, a second dinner being held on October 1 at Mojave. The aqueduct, which is designed to bring 400 second-feet of water to the city from Owens Valley 250 miles away, is a great work. The mining men were particularly interested in seeing the tunnelling, since records have been made both for progress in soft rock (1061·6 ft., in August 1909, at tunnel 17 M) and in hard rock (604 ft., in April 1910, South Portal, Elizabeth tunnel). The Elizabeth tunnel was visited by the party and full details as to cost and progress were supplied by W. C. Aston, the superintendent, and J. B. Lippincott, assistant chief engineer. The tunnel is in a schistose

SOUTH PORTAL ELIZABETH TUNNEL.

SUMMARY OF TUNNEL REPORT, APRIL 1910.

	Totals	Units	Total Cost	Unit Cost
Total footage to date	9738	—	—	—
Footage during April 1910	604	—	—	—
Required progress	240	—	—	—
Daily footage (30 days)	—	20·13	—	—
Required daily footage	—	8·00	—	—
Increase over estimated footage	364	—	—	—
Daily increase over estimate	—	12·13	—	—
Footage of untimbered portion	604	—	—	—
Estimated cost of untimbered portion	—	—	$24,238·52	$40·13
Actual cost of untimbered portion	—	—	15,257·61	25·25
Footage of timbered portion	—	—	—	—
Bonus footage	364	—	—	—
Bonus pay-roll	—	—	2,377·41	—
Cost of bonus per foot	—	—	—	3·93
Energy used, k.w. hr	78,379	129·76	—	—
Cost of energy at 0·0185 per k.w. hr	—	—	1,450·02	2·40
Estimated expenditure	—	—	24,238·52	—
Actual expenditure	—	—	15,257·61	—
Amount saved over estimated expenditure	—	—	8,980·91	—

gneiss, which is fairly hard to drill and which does not break beyond the holes. It is necessary to blast by the centre-cut system. Three shifts are employed and payment is on a premium basis. With this introduction the figures for the record month on preceding page may be read with interest.

JOHANNESBURG.

Bantjes. — Situated between the Vogelstruis Deep, lately closed down for want of funds, and the Aurora West, a mine well known for the greater magnitude of its promises than of achievement, the Bantjes Consolidated has been keenly and critically watched by a sceptical public. The news of trouble soon leaked out and a shortage of gold was alternately explained by the man with inside information as the result of residue losses and the discrepancy between the evidence of development and screen samplings. It is unquestionable that the results of the first few weeks gave real cause for anxiety, but it is also equally clear that the results of the second month's run are in accord with the probabilities indicated by ore reserve announcements. Previous announcements by the controlling firm have led to the belief that a stoping grade of 7 to 8 dwt. could be anticipated, which, reduced in value by development rock, and raised by sorting, should mean a mill grade of about the same figure, or say 30s. Thus theoretical recovery should be 27s. or 28s., making no allowance for the discrepancy commonly experienced on the Rand through over-valuation by sampling. Now compare the September results: Tons milled, 19,376 tons; yield, £25,622 or 26s. 5d. per ton. Screen values have lately been reported at 7½ dwt. Although it will take some time to get stopes and plant in good running order, there is no cause for agitation over early results, which show a fair margin of profit. On the matter of cost, it is to be hoped that some zones of profitable Main Reef will be found, to provide a reserve of cheaply won ore in support of the narrow and costly South Reef of the Maraisburg-Roodepoort district.

New Kleinfontein.—The drop of 6s. or 12% in the value of such a steady dividend-paying share as New Kleinfontein has occasioned astonishment, which the official statement has done little to remove. How far the trouble is due to a subsidence of an old stope and how far to decline in grade must be left to the taste and fancy of shareholders, for the declaration of the board is ambiguous. The grade of the reserve is declared to be down ½ dwt., or 7 dwt. against 7½ dwt. in December 1909, whilst the profit is to be reduced from £25,000 to £20,500. The company is increasing its capacity by 10,000 tons per month, which should more than compensate for the drop in grade, and the question of prime importance is whether the unfavourable developments portend evil for deep level companies on the dip.

FLUME METHOD OF HANDLING SLIME AT THE NEW MODDERFONTEIN.

Simmer and Jack. — It is characteristic of the spirit of criticism and fault-finding that seems to pervade the mining atmosphere of the Rand today, to the detriment of solid progress, that the chairman's able speech at the meeting of the Simmer and Jack should be more

noteworthy for its treatment of certain debated questions of policy than for its exposition of the results achieved. Yet it must be admitted that Mr. Drummond Chaplin's announcement as to the treatment of low-grade ore was of peculiar significance, and indicates clearly that, whatever rumour may have indicated, the Consolidated Gold Fields has remained loyal to the standard of 'wholesale mining' which has benefited the Rand so remarkably in recent years. Mr. Chaplin referred to the "increased amount mined of low-grade ore not formerly included in the payable ore reserves." He added—"It is found that a profit can be obtained from this ore and it is obviously to our advantage that it should be milled even though its inclusion tends to reduce the average grade, and particularly that it should be milled now, seeing that a return to old stopes or areas in after years does not generally lend itself to cheap mining." A more emphatic and reassuring statement, in direct opposition to the principles of a dangerous selective policy, could not be desired.

Disappearing Sand Dumps.—In a brief type-written note upon the most interesting portions of the reduction works, given by the Simmer & Jack Proprietary to a party of visitors on September 24, attention is drawn to the sand-filling arrangements. The company employs current residues. "The 60% of clean sand yielded by the crushed ore," it was remarked, "occupies about the same space in the mine as the ore, before it was mined a fortnight earlier." This non-sensational statement suggests one probability about which there appears to be wide misunderstanding, namely, that with the more extensive application of the sand-filling process the unsightly dumps will disappear. Such optimism is unwarranted. Current residue will long satisfy our needs, sand-filling will check the growth of many dumps and may appreciably reduce a few; but, broadly speaking, it is to be feared that the frequently anticipated disposal of Rand dumps is an extravagant ambition. Whether existing dumps, destined to receive no fresh contributions, cannot be covered and planted is a more practical question.

South East Africa, Ltd.—Until the report of their annual meeting reached Johannesburg, it was never thought that the operations of the South East Africa, Ltd., would be of any interest to the Southern Transvaal. It is to be seen from Dr. Carl Peters' speech that attention is being directed to the subsidiary synclinal basin of Witwatersrand formation to the southeast of Heidelberg, commonly known as the Daspoort line, from the farm on which the deepest drilling was done. It is most satisfactory that a strong company should attack this area. Since it was first thrown open to public pegging by proclamation early in 1903, it has been in the hands of small holders or lying neglected. Little serious work has been done, and little indeed appears to have been warranted by the results to date. The farms showing outcrops of banket with some gold are Malan's Kraal, Tweefontein, Rietfontein, and Daspoort. The third named is mentioned by Dr. Peters with special favour, on account of the development done there in 1904–5. Passing over the absurdity of using the results obtained in this prospect as a basis for calculation of profits on 60,000 tons per month, it may be fairly said that a mining company, willing to spend money on speculative work, stands as good a chance of striking payable ore in this district as in any other Witwatersrand banket area outside the Rand proper. The present stage, however, is not one of counting possible profits, however fascinating this pastime may be.

Administrative Changes.—The Rand has seen many important changes in consulting and managerial quarters during the last few months and several of the industry's oldest and most valued workers have left its service. During the twelve months ending in April 1911, the consulting engineers to five groups will have resigned. Earlier in this year Leslie Simson (Consolidated Gold Fields), W. W. Mein (Eckstein's), and Harry Johns (Barnato's) finally severed their connection with the firms they have served for many years, and have been succeeded by C. D. Leslie, W. T. Anderson, and J. G. Lawn, respectively. B. Kopellowitz has now left the Albu group, his successor being as yet unknown. The impending retirement of G. E. Webber, consulting engineer to the Rand Mines, Ltd., will involve the loss of a giant in the engineering world on the Rand. There is no engineer who has worked harder and more effectively to establish Rand deep level mining on a sound and prosperous basis. The word 'sound' is used emphatically. The policies of Mr. Webber have been noted for their steady force.

Shaft-Sinking Difficulties in East Rand.

Although the Far East Rand holds all records for rapid shaft-sinking and development work, its recent records have shown little in the way of speedy progress on the new mines. In shaft-sinking, the records of the Brakpan mines have seen no equal. Other and later

work has been hindered by water difficulties. The two shafts of the Springs mines stood at 500 ft. and 550 ft. at the end of September, little headway having been made during the previous quarter, owing to influx of water and bad ground. The Grootvlei Proprietary has experienced even greater trouble, one of its shafts standing idle at 55 ft., while the other has been temporarily stopped in order to investigate the deeper ground by drilling. The influx of water reached 1,700,000 gal. per day. The Rand Klip is another company sinking through the same formation in the East Rand that has experienced serious water troubles and shown poor progress in consequence. Two shafts are being sunk, for all these new mines in the Eastern basin are of such extent that the practicability of connecting with the shaft of a neighbouring property, to meet the requirements of the two-shaft regulations, is remote. Progress has been slow in both, owing to shortage of suitable labour and big influx

Commissioner Street, Johannesburg.

of water through the dolomite. The Rand Klip shafts are being equipped with steel setts, E. J. Way, the consulting engineer of the group, being one of the Rand's keenest advocates of the system.

Rand 'Science.'—Though the Rand is noted for the high quality of the scientific papers read before societies and published in the Press, we occasionally are treated to farcical outbursts of pseudo-science. A week ago an alleged geologist was allowed to propound in print a theory as to the igneous origin of the Rand deposits. The whole paper was a fanago of absurdities.

MELBOURNE.

Export Duty.—On different occasions the possibility of the Australian Commonwealth placing an export duty on the lead and zinc concentrates of Broken Hill has been mentioned. The subject has now come up in a more direct way in two different quarters. In the first place the Smelters' Union has been moving in the matter and seeing the domination of the Labour party in Federal politics, it can be assumed that their representations alone would have weight. But they have now been joined in the request by the Newcastle Miners' Federation, which, after the Australian Workers' Union, is the most powerful trade combination in Australia. Here is the force behind the throne, because with the Newcastle Miners is closely associated the Australian Seaside Workers' Union. Let these three organizations combine and the caucus will soon let the Labour Government know how it is to move. But the Labour people are not alone in drawing attention to the export of raw products that could be handled in Australia. G. D. Delprat, the general manager of the Broken Hill Proprietary Co., speaking at Port Pirie recently, said that the export of ores from Port Pirie for the past six months amounted to 220,000 tons. He would like to see it dwindle down to nothing. It was a slur on Australia that Broken Hill should be sending ores for treatment to Europe and America. The work should be done in Australia by Australian brains, Australian capital, and Australian labour. The Proprietary company now smelted the whole of the Broken Hill ores produced with the exception of those from two mines, which it hoped to capture when next their ores were on the market. The Proprietary company had done a daring thing in spending £100,000 on an up-to-date zinc plant, but they now had two furnaces at work, and found that they could produce zinc at a profit. At the end of this year they would be treating 22,000 tons of concentrates per annum. He hoped that other companies would refrain from exporting to Germany ore that could be well treated in Australia, notwithstanding the uncertainty of labour conditions. In connection with the production of spelter, he could quite see the probability of the erection of a sulphuric acid plant at Port Pirie in the near future, followed by super-phosphate works.

It may be assumed that these remarks by Mr. Delprat will find a response not only in Labour circles but in the protectionist camp. Moreover, they will appeal to the patriotic

side of the community which reads in every bit of news of German naval activity a spirit of aggression against the solidarity of the British Empire. Therefore on a variety of grounds, though exports duties are economically unsound, the suggestion may be put into effect, with a stipulation that any provision made in contracts to pass the tax on to the companies here shall be null and void.

Dredging.—The Minister of Mines is discarding all the traditions of his department in respect to the relationship between it and the Lands department. The latter is 'bossed' by the farmers and these are trying their best to kill the dredging industry by compelling a return of practically pure water to the streams from the dredge-dams. The limit of solids per gallon of water is now 700 grains and the Minister states that he will not object to that quantity being reduced to 400 grains. The farmers want 200 grains. The injustice of the whole thing is that the bulk of the silt in the rivers comes from the loose soil washed from cultivated fields during the summer thunderstorms. The farmer won't grasp that fundamental fact. That a dredge is working 20 miles up the stream in shingle beds is enough for him to avow that the whole stream is being polluted and filled by the sludge from the dredge. At the present moment the whole of the dredging industry in Victoria is being threatened in consequence of the *laisser faire* attitude of the Minister of Mines.

Bendigo.—The most interesting mining development in Eastern Australia of late has been the striking of rich ore on the Sheepshead line of reef at Bendigo. The bulk of the mining at that centre in the past has been done on the Garden Gully, New Chum, Hustlers, and Moon saddle formations. Immense sums have been won from them and as a result the old pioneers would not mine persistently away from them. They sank the deepest shafts in the world on these lodes and at the Victoria Consols now propose to go down to over 5000 ft. But there are a number of side lines that have been slightly prospected. The poor returns coming from the deep mines on the main lodes has led the Lansell estate to do some prospecting on the 'little 180' mine on the Sheepshead line. Good ore was struck. Now the adjoining mine, the Central Red White & Blue, has struck it. The importance of this is that prospecting will be induced some distance from the main lines. E. J. Dunn, the Government Geologist, has for years been recommending action in this direction but has met with little response. Not less interesting is the fact that money is now forthcoming to test the corresponding saddle country at Castlemaine, some distance from Bendigo. Castlemaine was immensely rich as an alluvial field but lode-mining has never paid, the work having been done in a more or less haphazard way. Now the geologist has been called to the aid of the miner and he has picked out a special locality for prospecting. So we shall see what applied science can do.

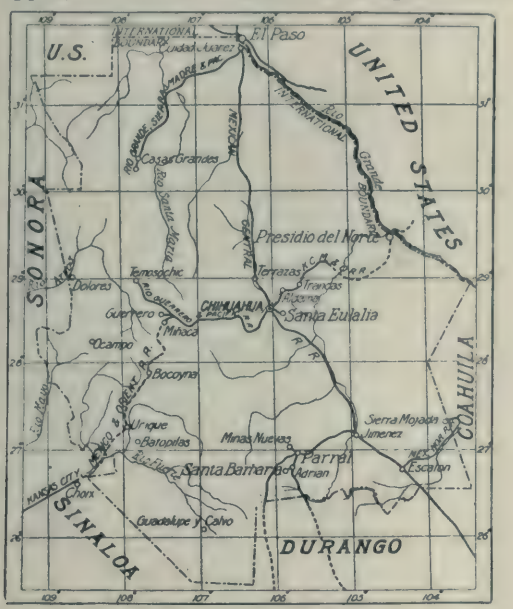
Hampden.—The fates have been kindly to the Hampden Company, at Cloncurry, Queensland. In the first place the mine has

Eastern Australia.

been developing most satisfactorily; next, the company alighted upon a treasure in the Duchess mine, which it obtained for a mere song from Tolhurst & Keats. But the Duchess is some distance from the Hampden and so a railway 35 miles in length has to be built. The company is now on the point of raising £60,000 of debentures to cover the cost of building the line, provided the Labour party in Queensland permits the company to do so. There can be little doubt on this point. The idea at the moment is to allow debenture holders to convert their bonds into shares at par, and to allow interest at the rate of 6½% on the bonds, with an underwriting commission of 7½%. The company has about £1,000,000 of ore proved

in the two mines, so that there has been no difficulty in financing the issue. The construction of the smelter is being hastened.

Mount Elliott.—The first result from the Mount Elliott smelter after the re-organization of the plant by W. H. Corbould has been announced; 4415 tons was treated for 525 tons of blister copper, containing 857 oz. gold and 725 oz. silver. The average grade of the ore works out at over 12% copper, 4 dwt. gold, and 3½ oz. silver per ton. The cost can only be assumed, but judging from previous experience it is probably £27. 10s. per ton of copper, exclusive of realization charges, which



The State of Chihuahua, Mexico

should be about £7 per ton. Australian shareholders in the company are not numerous but they like to know how their mine is being managed, and what results are being achieved. The general belief is that the Mount Elliott output has left a profit of about £15,000, but no one here knows. This is one of the matters in which people in London partly owning mines on the Eastern slope of Australia make a fundamental mistake. The British Broken Hill, for instance, is almost a sealed book; so is the Sulphide Corporation, so are the Great Cobar and the Mount Elliott. If those who have interests in Australia do not wish to be singled out as absentees, and to have special imposts and special legislation introduced for their benefit, they must make it clear that they are not playing the part of barnacles. Let them be frank in respect to their outlay and their receipts, let them also not provoke hostility by bottling up information in London to the disadvantage of the man in Australia who holds an interest in the mine. The directors of the Mount Elliott ought to know this as well as people on this side, for most of them are Australians who would be the first to exclaim if deprived of the information to which they believed they were entitled. Bewick, Moreing & Co. have set the example here in the matter of furnishing monthly details of costs and expenditure and the Mount Elliott Company should try to do likewise.

MEXICO.

Bolaños.—These old silver mines in the northern portion of Jalisco, credited with a production of over 500 million ounces, are to be again operated. The Bradbury interests, of Los Angeles, owning and successfully operating the Minas del Tajo in the Rosario district of Sinaloa, have acquired control of the properties by purchasing the rights of the Bolaños Mining Co., of St. Louis, and effecting a merger with Juan B. Izabal, of Guadalajara, who formerly held title. Izabal was instrumental in the organization of the Bolaños company several years ago, but later he became involved in litigation with the American concern, the case going to the Supreme Court of Mexico, where a decision favourable to the company was rendered. However, even after this decision, Izabal's stock-holdings left him in a position to name terms. The Guadalajara man obtained title to the properties from representatives of the Eagle Mountain Mining Co., an American concern organized in the '80's, which also had a history of litigation, and which, like the Bolaños Co., accomplished little. The English syndicate that worked the Veta Grande at Zacatecas in the last century also worked the Bolaños mines, under lease and with great profit. According to credited accounts, at the expiration of the lease the owners demanded double the original rental, or 800,000 pesos yearly, for a renewal, and when the syndicate objected arrangements were made for an examination of the mines with a view to proving that the demand was justified by conditions. With the object of preventing this examination the Italian manager of the English interests set fire to the timbering of the main shaft, and later, the fire getting beyond control, the waters of the Bolaños river, then used for power purposes, were turned into the mine. The old workings have never been unwatered. Pumping equipment has been ordered by the Bradbury

interests, and the old road from Zacatecas is being repaired.

Pacific Smelting & Mining.—The 150-ton lead smelter erected at Guaymas, in Sonora, several years ago by the Mexican-American Smelting & Refining Co., a W. C. Greene enterprise, has been taken over by the Pacific Smelting & Refining. The acquisition strengthens the position of the company in relation to custom smelting on the West Coast of Mexico. Practically no smelting has been done at Guaymas, the furnace having been blown in' simply to comply with and hold the State concession under which it was built. The plant is being overhauled and every facility for the treatment of lead ores will be provided. Copper ores will be smelted at the company's Fundicion plant, where later copper converting equipment will be installed. The company is actively in the market for ores, but will not start smelting until accumulated supplies and contracts guarantee continuous operation. The plans of the Pacific Smelting & Mining mean much to West Coast mining. Courtenay De Kalb is in charge.

Cyanide Plants.—Two large and complete plants for cyanidation will be soon in operation in the Parral district of Chihuahua. One is the first unit of the projected 1000-ton plant of the Palmilla Mining Co., a subsidiary of the Alvarado Consolidated Mines Co., and the other that of the Veta Colorado Mining & Milling Co. Both have been built under the direction of Bernard MacDonald, of Guanajuato, and are about of equal capacity, 300 tons daily. The Palmilla mill will handle custom ores as well as those of the Palmilla mine. In anticipation of early milling, the Alvarado company is putting the Palmilla in shape for steady production. This is the property that raised Pedro Alvarado, a mine labourer, to the millionaire rank and kept him there for a time—until systematic development and management became necessary. The construction of the Veta Colorado plant was started a few years ago, but on account of company difficulties it was not finished. The work of Mr. MacDonald has included remodelling as well as finishing. The company controls the Quebradillas and other mines on the great Colorado vein of the Parral district.

Zacatecas. — An association has been formed by the foreign mining men of the Zacatecas district, with a view to bringing about a revival in that old mineral district, at one time one of Mexico's principal sources of silver. The opportunities and advantages of the district, as well as the results obtained by modern methods, will be made known, and in this way it is expected to attract capital for extensive operations. An important feature in connection with the future of Zacatecas is the plan of the Chapala Hydro-Electric Co., of Guadalajara, to transmit a plentiful supply of power and deliver it at comparatively small cost. This concern is building transmission lines to mining districts in the State of Jalisco. The new concentrating and cyaniding plant of the Zacatecas Mining & Metallurgical Co., now ready for operation, will do custom work, and should help properties other than those of the company. The 50-ton custom plant at the city of Zacatecas, in which the State government has an interest, has been in operation for some months, but the results have not been satisfactory. A part of the trouble has been due to the varied character of the ore that the plant has been treating. Some remodelling is required. Old tailing from the Laguna de Guadalupe is to be treated in a cyanide plant now nearing completion, built under the direction of Rodolfo Muñoz, a Zacatecas engineer. The tailing, estimated at several million tons, will be collected in scrapers and taken to the plant over tramlines. At the Rio Tinto properties the Zacatecas Syndicate, Ltd., representing the A. Goerz interests of London, has installed pumping equipment of greater capacity, that originally provided having proved inadequate. The concentrating plant of the Eden Mining Co. is being enlarged.

Guanajuato.—Fifty stamps will soon be added to the number dropping in this old district. The reduction plants of the Providencia Mining & Milling Co. (40 stamps) and the Tula Mining Co. (10 stamps) are nearing completion, and will figure in the output of the district in 1911. The Providencia owns the Tajo de Dolores mines, where much development work has been done, and where the proved tonnage is sufficient for several years of mill operation. It is expected to handle 250 tons daily. The enterprise is controlled by the Proprietary Mines Co. of America, also in control of the Nueva Luz enterprise of the Mineral Development Co., in the Guanajuato district. The Trinidad and Los Locos mines of the Tula Co., at La Luz, have been under development for some years, and are in condition to keep the new mill steadily in operation.

Motor Transport. — The mountainous State of Guerrero boasts the only automobile road of any consequence in Mexico. It

extends from Iguala, a station on the Balsas line of the National railway, 238 kilometres south of Mexico City, to Chilpancingo, the capital of Guerrero, 117 kilometres. It was built by the Federal and State governments, jointly, at a cost of 800,000 pesos, and it has reduced the time between the two points from three days to a few hours. At places in the mountains the road extends through solid rock, and in the open stretches it has been thoroughly macadamized. There are 120 masonry culverts, two steel bridges, and many retaining walls. Freight is handled to the railroad from Chilpancingo and intermediate points in large freight automobiles.

Prospecting in Sonora.

CAMBORNE.

Levant Mine. — This mine continues to work at a small loss. The accounts issued for the 16 weeks ending October 14 last showed an excess of expenditure over receipts of £465 or 1s. 3d. per ton stamped. In this loss was included £200 written off an irrecoverable debt as well as £240 for half lord's dues, so that, allowing for the former, an increase of 1 lb. of black tin per ton at present prices, and on the existing rate of production, would be sufficient to turn the scale in favour of the adventurers. The output for the 4 months was 7418 tons, and the expenditure was £12,691 or 34s. 2d. per ton, and the receipts were £12,226 or 32s. 11d. A call of 4s. was made to square the books. The most pressing difficulty at Levant at the moment is the dearth of miners. With the increased opportunities for work in the St. Just district at North Levant, Botallack, Boscaswell, etc., miners fight shy of Levant which, as anyone knowing the conditions will readily recognize, is not the best of places to work in. The executive is now talking of importing Italians to increase the underground force. It is only after having tried various schemes to attract miners, all of which have failed, that this important innovation has been thought of and there is no reason why it should not be successful as the Italian miner has proved himself a good workman on foreign fields and will probably shame many of the miners at present employed in Cornwall by the amount of work he will get through. The efficiency of labour in Cornwall today is very poor, and if our mines are to prove remunerative on produce of the existing average, then this question will require the serious attention of the executives in the near future.

Boswin.—This little mine at Wendron continues to be vigorously developed and the main shaft is being deepened to 60 fm. below adit. Having proved the existence of sufficient ore to warrant the erection of a mill, a 30-ton per day dressing plant, including a pair of Holman air-cushion stamps, is to be put in hand forthwith. If some other Cornish companies, whose names we need not mention here, had taken the precaution to make certain that they had the ore to treat before erecting dressing plant, the industry in Cornwall today would, in all probability, be in a much more flourishing state than it is.

Carn Brea and Tincroft.—It is cheering news that a Wetherill magnetic separator is to be installed by the British Humboldt Engineering Co. at this mine owing to the generous action of Lord Clifden, and there can hardly be a doubt that the result will be equally as satisfactory as at South Crofty and East Pool, where the conditions are not dissimilar.

Wheal Kitty.—The recent issue of preference shares proved a success, although only a small proportion of the money was secured from Cornwall. Good progress is being made with the erection of the big pumping engine house at Sara's shaft, and preparations are being made for the 18 in. pumps which are to be installed to the 540 ft. level, before sinking the shaft another 50 fathoms. As there is a water communication between Wheal and West Kitty, an arrangement has recently been made by which the latter company will keep both mines dry by means of their Cornish pump in Reynolds' shaft and this will enable Wheal Kitty to stop the working of its Worthington pumps, and employ, if desired, the electric power in another direction. Anyhow the arrangement will mean a considerable saving to both companies and it is satisfactory to see that the ill-feeling between the two

concerns, which existed when West Kitty was working as a cost-book company, has now passed away.

West Kitty.—Developments on a considerable scale are now being carried on at this mine, no less than six rock-drills being employed. While official information is scarce either from the liquidator of the old company or the present board, yet we hear that these developments may be regarded as satisfactory, and particularly, that the West Kitty lode in the bottom of Friendly shaft, which is now being sunk on the lode, is looking very well.

Phœnix.—Satisfactory progress is being made in the equipment of this famous old mine both above and below ground. The second plunger lift from the 360 ft. to the 720 ft. level at the Prince of Wales shaft has been fixed, and a drawing lift installed to keep the bottom of the shaft dry, while the cross-cut in the direction of the old mine has been started. The mill buildings are also nearing completion.

SALT LAKE CITY.

Copper.—The past month has witnessed a continuance of the policy of curtailment on the part of the Utah Copper Co., but a marked increase in production by the Ohio Copper and the resumption of output by the South Utah, better known under its old name of Newhouse Mines & Smelters. For the month of September Utah Copper's output was about 7,100,000 lb., as compared with 8,677,851 lb. for July. The largest production was last May when it reached a total of 8,862,900 lb. One section of the Ohio mill is running and during a recent day treated 2096 tons of ore. This is almost double the rated capacity, which was 2250 tons for the two sections. The South Utah started its mill in the early part of September. This company is under contract to ship 100 tons of concentrate daily to Tooele. This means the treatment of about 1000 tons of ore. Boston Consolidated found that it could hardly more than meet expenses on 3000 tons of low-grade ore per day and as the Newhouse deposits are very low in copper and the water-supply limited it hardly seems possible that any great profits can accrue from the operations of this company at present prices.

The Utah Copper Co. has purchased Copper Center gulch, which will be used as a dumping ground for the overburden from the stripping operations. This has necessitated the moving of the buildings of the Bingham Mines Co. to the mouth of the Niagara tunnel, through which the latter company will operate. This means that production will cease until the connection can be made between the tunnel and the workings of the mine, a task that will require about three months. With the added dumping ground Utah Copper will go ahead more vigorously than ever in developing the ground acquired from the Boston Con. A total of 18 steam-shovels is now at work and three more have been ordered and will be set to work as soon as received. The company is planning to spend about $200,000 in locomotives for the new Bingham & Garfield Railroad. These will be Mallet articulated compound and will weigh 300 tons each. The grading of the road will all be completed during the month of November, with the exception of the tunnels. These will be driven during the winter and by spring the roadbed should be ready for the rails.

F. Augustus Heinze is quoted as saying that all of the machinery necessary for the completion of the Ohio mill will be on hand within two months and the mill be complete in four. There seems to have been some delay in the financing, however, and it would not be surprising if more than this time elapsed before the mill is running at full capacity. It is understood that Mr. Heinze's present trip to Europe is largely for the purpose of completing the financing of this property. Colin McIntosh, who has been manager for the Ohio since the present company took hold of it, has tendered his resignation and will be succeeded by Alfred Frank, chief engineer on the Heinze staff. Mr. McIntosh has handled the Ohio through a very trying stage in its career and has brought it into the ranks of the large producers. His retirement from this company is the cause of regret to many who have been watching it with interest.

Litigation.—Arguments in the case of Silver King Consolidated v. Silver King Coalition have been concluded and this case is now in the hands of the judge. The suit is for an accounting for ores illegally extracted and involves an amount of $5,000,000. The defendant has admitted taking ore, but claims that it was in small amounts and was of little value.

After several years of negotiation a merger has been consummated between the West Quincy and the Thompson mines under the name of Thompson-Quincy Consolidated. The Ontario adit will be extended from the Daly West so as to drain the property and in return portions of the stock are given to the Ontario, Daly West, and Daly. The question of a merger of several of the large mines of Park

City has been agitated for some time and there is considerable speculation as to whether the Thompson-West Quincy is not the preliminary step to a much larger consolidation.

Nevada Consolidated is maintaining its lower production, the output of copper for the month of September being 5,270,000lb. against 6,896,422 lb. for July, the last month before the policy of curtailment went into effect. The company is working as many men as usual but is employing more at Copper Flat and fewer at the mill and smelter. Work of stripping the orebody at Liberty Flat is in progress and this portion of the ground will be in ore not outskirts of Ely. The first will require the building of a large pumping-station and the latter a railroad.

Ely Central received a severe blow when the offices of B. F. Scheftels & Co. were raided and the officers of the company arrested for using the mails to defraud. This firm handled the Ely Central stock and it is not yet known to what extent the company will be affected. Since the raid the stock has fallen to less than 20 cents per share. The stockholders seem to have confidence in the management and there is reason to believe that the property is both valuable and well managed.

JARBRIDGE, THE NEW GOLDFIELD IN NEVADA.

later than March. During July and August, before the output was decreased, the earnings were sufficient to pay the dividends of the third quarter, $750,000.

Giroux.—Two pumps are being installed on the 1200-ft. level of the new shaft, one of 1200 gal. capacity and one 600 gal. A deal of much importance was consummated when the Cole-Ryan syndicate purchased the East Ely townsite from the Gunn-Thompson Co. for a sum understood to be $5,000,000. The Cole-Ryan people are not in the townsite business, so the purchase is understood to be for the securing of the water rights that go with the site. The Giroux has been figuring on a smelter for some time and the only available water rights are those that were held by the Gunn-Thompson syndicate. The plant will be erected either at the Giroux mine or on the

Jarbridge, the new camp near the Idaho border, has made its first shipment of ore, namely, 110 sacks, from the Four M lease, estimated to run $2000 to $3000 per ton.

The former boom camp of Chafey has been closed down and not a single property is now working. Under a judgment of the courts the principal properties passed into the hands of some Salt Lake bankers and will remain idle for the time being, at least.

The election of E. R. Wooley to the presidency of the Nevada-Utah of Pioche will doubtless mean much for this camp. Nevada-Utah and Ohio-Kentucky have been at outs for some time owing to disputed ground. A company was recently organized to take over the territory in question and the selection of Mr. Wooley to the presidency of Nevada-Utah will insure harmonious co-operation.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

October 1910.	September 1910.	October 1909.
£56. 16s. 2d.	£55. 6s. 5d.	£57. 13s. 2d.

The stronger tendency and improved sentiment which began to manifest itself towards the end of September has steadily increased during October. The raising of the Bank Rate to 5% did indeed for a short time bring a halt in the advance of prices, following a flood of realizations by bulls taking profits or being frightened by the heavier contango rates. The month however ended with prices £3 above the opening of the month. Confidence has been restored to consumers and the public by the long continued declines in European stocks, and perhaps more by the publication of the Rio Tinto Co.'s interim report confirming the reduction in output arranged among producers. This the first official pronouncement on the subject has been immediately followed by greatly increased activity in the speculative market which at times showed its old vitality. General causes contributing to the improvement are the certainty of good American crops, the improvement in the economic situation, the approaching close of the election campaign with its unrest and the decline for September of 3500 tons in the American production. The Stock Exchange generally early to anticipate changing conditions has undergone a complete alteration in sentiment and prices are less susceptible to bear attacks while the sales of bonds have increased. European merchants have during the month bought an increased amount of electrolytic copper from America for delivery this year and also during January, and the accumulations on the other side are now disposed of. Much of these purchases have been resold as standard. Consumers however who have looked for a setback to purchase ahead are doomed to disappointment, as the Americans find themselves independent of the standard market. January electrolytic is selling at £60.

There is no change in the attitude of consumers to the market. The heavy and continued declines in stocks testify to their activity. The demand is abnormally large and regular. The Italian sulphate makers have purchased liberally. In America buying has temporarily slackened although deliveries are reported to be good, but after the elections a fresh rush of buying is expected.

TIN.

Average prices of cash tin:

October 1910.	September 1910.	October 1909.
£164. 4s. 9d.	£160. 8s. 7d.	£138. 13s. 2d.

The tin market continues to be wild, prices moving up or down as suits the books of those who so completely control it, and dealing is frequently exceedingly difficult. The attempt to manipulate prices by reshipments from New York signally failed as such an attempt must and cash tin has been dealt in at £171 or £15 above last month's close. This level has been reached through the covering of the still formidable short interest and we close about £5 lower, which still shows a substantial advance for the month. American supplies are so low that all earlier arrivals here were sent direct to New York and at the same time deliveries were rushed from store via Southampton. Supplies show a reduction of 1372 tons for the month which was better than the trade expected. Bull speculators show more interest in the market since the disappearance of the backwardation. The demand for tin plates is enormous.

LEAD.

Average prices of soft foreign lead:

October 1910.	September 1910.	October 1909.
£13. 2s. 0d.	£12. 12s. 6d.	£13. 4s. 4d.

During the great part of the month lead has shown unwonted activity and a persistent rise in prices. Certainly supplies reaching the London market have not been small but the demand from manufacturers has not only eagerly absorbed all arrivals but considerably encroached on stocks held in warehouse. An advance of 12s. 6d. was established. At the month's close the demand fell off and prices had a set back, but the underlying conditions are exceedingly favourable.

SPELTER.

Average prices of ordinary brands:

October 1910.	September 1910.	October 1909.
£23. 16s. 6d.	£23. 2s. 7d.	£23. 3s. 4d.

Spelter shows an advance in price of about 10s. per ton and the renewal of the zinc convention has given a further impetus to demand. There is no abatement of the buying power of the trade in spite of the repeated advances in price made by producers. Consumption is breaking all records.

PERSONAL

F. W. BRADLEY is at New York.

JUAN F. BRANDES is in Mexico.

GERALD M. BROWNE left for South Africa early in October.

L. N. B. BULLOCK, who is with Charles Butters & Co., sailed on November 5 for New York and Mexico.

GELASIO CAETANI has returned to San Francisco from Nicaragua.

HERBERT CARMICHAEL, Government Assayer for British Columbia is here from Victoria.

T. LANE CARTER is in Sonora, Mexico.

A. O. CAUTLEY sailed for Nigeria on October 19.

J. H. CURLE was in Greece during October.

W. R. FELDTMANN is due from West Africa.

F. C. FREY, manager of the Simmer Deep, is in England and will return to the Rand in February.

B. G. C. GARD'NER has gone to Northern Nigeria for the Anglo-Continental Mines, Ltd.

C. S. HERZIG is in Mexico.

W. L. HONNOLD has returned to London from the United States.

G. HOOGHWINCKEL has returned from Mexico.

C. BARING HORWOOD, one of the general managers of the Randfontein South Mines, will be in England at the end of November.

CHARLES HOYLE is manager of the Esperanza mine, at El Oro, Mexico.

J. P. HUTCHINS and NORMAN STINES are in London, on their return from Eastern Siberia.

ALFRED JAMES has returned from a short visit to New York.

CHARLES E. KNOX, of Tonopah and San Francisco, is here.

W. M. KNOX passed through London on his return from Ouro Preto, Brazil, to San Francisco.

HASELDEN LEWIS is leaving for Africa to become smelter manager for the Tanganyika Concessions.

ERNST LICHTENBERG sailed on October 22 for Nova Scotia and will be absent six weeks.

HENRY LOCKHART, general manager of the Mines Management Co., New York, is in London.

GERARD LOVELL is manager for the Burma Mines Ltd., at Mandalay.

JAMES A. MACTEAR returned to Ashanti on November 9.

E. P. MATHEWSON, accompanied by Mrs. Mathewson, is making a European tour, and is now in Switzerland.

C. W. MERRILL, of San Francisco, is in London.

ARTHUR L. PEARSE was recently at Juneau, Alaska.

H. A. PIPER will be at Bulawayo from December 31 to June 30.

H. POMEROY, Jr., is engineer and submanager with the Cia. Minera de Andacollo, at Coquimbo, in Chile.

W. H. RADFORD passed through London on his return from Siberia to San Francisco.

THOMAS T. READ is expected from China, by way of Siberia.

F. A. D. RICHMOND and R. T. HANCOCK have gone to Northern Nigeria to act as assistant managers with the Nigerian Tin Corporation.

EDGAR RICKARD returned from New York on October 24.

FORBES RICKARD is examining the San Juan mine in Lower California for Hooper, Speak & Feilding.

J. R. H. ROBERTSON left Penhalonga (Rhodesia) in June and is now with the East Rand Proprietary, at Johannesburg.

C. H. SHAMEL is in the Philippine Islands.

J. D. AUDLEY SMITH has resigned as manager for the Queensland Copper Co., to open an office as consulting mining engineer at Sydney.

J. E. SPURR was recently at Tonopah, Nevada.

OTTO SUSSMAN, of Salt Lake and New York, is in Germany.

A. ERNEST THOMAS is in Northern Nigeria, expecting to return to London in January.

P. B. WAUGH is expected shortly on his return from Northern Nigeria.

O. F. WESTLAND has become general manager in Mexico for the Mines Management Co. of New York.

ERNEST R. WOAKES has returned from Spain and will go forthwith to Hungary.

THE PORCUPINE GOLDFIELD

By A. L. SIMON.

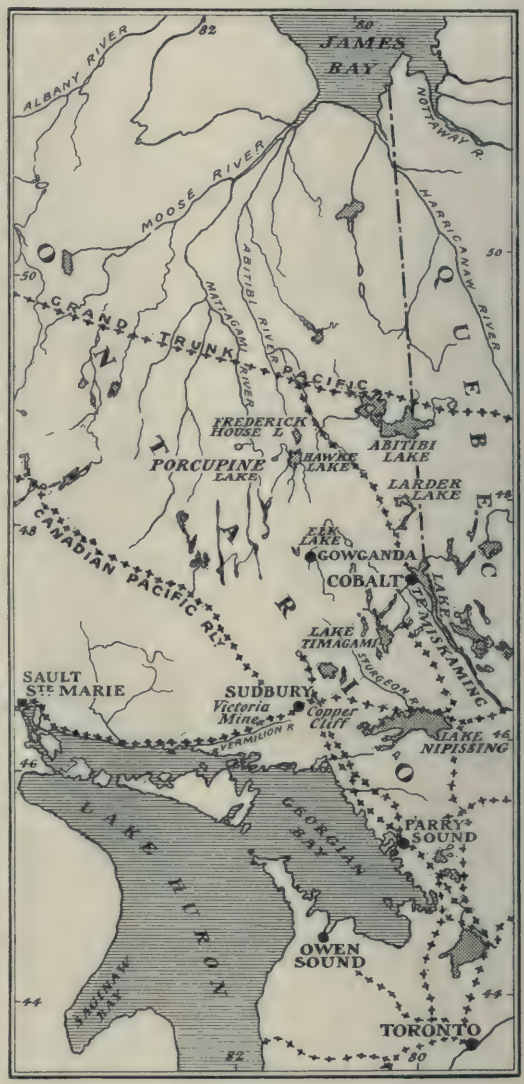
THE 'gold area' of Porcupine, as it is officially called, is situated in the district of Sudbury, Northern Ontario. This district, like others in Canada, is divided into townships, that is, square blocks of land, the sides of which, 6 miles long, generally run from north to south, and east to west. Each township bears a name; those that are of special interest in relation to Porcupine are Whitney, in which the lake and settlement of Porcupine are situated, and, to the west, Tisdale, where the most important finds of gold have been made. South of the latter is the township of Deloro, while to the east and south of Whitney is that of Shaw.

The townships of Whitney and Tisdale have been surveyed for sub-division into 'veteran' and ordinary claims. The former are square plots of land having sides half a mile long and covering 160 acres. They have been given to 'veterans,' namely, men who fought in the South African or other wars. The holders of these claims are said to have special privileges with regard to labour conditions, and the patenting of claims. This requires further confirmation, as I cannot find any special reference to the matter in the Provincial mining regulations.

The ordinary claims are square plots of land covering 40 acres, having sides ¼ mile long and running parallel to the orientation of the townships. In certain special cases when townships have been sub-divided into lots different from the above, the size of a claim may vary from 18¾ to 50 acres. Details as to size are to be found in the Mining Act of Ontario, 1908.

The townships of Deloro and Shaw are in the Temagami Crown forest reserve. Their boundary lines have been surveyed, but no sub-divisions have been delimited. To prospect or work in such a reserve necessitates the observation of a number of special regulations and the obtaining of special permits.

The holder of a mining claim has to fulfil specific labour conditions before a patent is obtainable; he must satisfy the Mining Recorder that 30 days' work (of 8 hours per day) has been done on the claim during the three months immediately following the recording of the claim; for the first and second year thereafter 60 days' work must have been performed in each year, and during the third year at least 90 days' work must have been done on the claim. Within the period af 3½ years the claim may be patented, after proper survey and the payment of $3 per acre in surveyed territory and $2.50 per acre in unsurveyed territory. A claim once patented is held in fee simple.



Northern Ontario. Showing the new mining districts.

The route to Porcupine starts from milepost 222, known as Kelso, on the Temiscam-

KELSO RAILWAY STATION.

HILL'S LANDING, PORCUPINE.

ing & Northern Ontario railway, which starts at North Bay on the Canadian Pacific main line, passes through Cobalt, and terminates at Cochrane, where it joins the Grand Trunk Pacific line, now under construction. The station at Kelso consists of two old railway cars in which are to be found the general waiting-room, ticket-office, Dominion Express Co.'s office, telegraph, post-office, etc. Facing the station is an hotel known as Miller House, a comfortable and well managed establishment. The only train from the South is due at Kelso at about 7 p.m. and the train for the South leaves Kelso at 9 a.m., so that both arriving and departing travellers have to spend the night at Miller House.

Besides Miller House, there are other hotels of minor importance at Kelso, as well as a few shops and a smithy. The 'stage,' an open wagon, leaves Kelso at 7 a.m. and takes from 3 to 4 hours to cover 11 or 12 miles. It arrives between 10 and 11 a.m. at Frederic House, a camp on the shore of Frederic House lake, where gasolene launches are in readiness to bring the visitor to Porcupine, up Frederic river, over Night Hawk lake, thence three miles up the Porcupine river to Hill's landing.

The whole distance covered by the launches is about 15 miles. A new road, 8 miles long, leads from Hill's landing into the Government town-site of Porcupine. The road, which may be more accurately called a mud trench, is a clearing through the forest, but, owing to its soft nature, does not allow of any wheeled traffic. Two mud-sleighs, locally called 'jumpers,' each drawn by two horses, manage to cover the 8 miles in 3 hours. Most people walk. The worst places on this stretch as well as the worst places on the road from Kelso to Frederic House lake, have been laid with 'corduroy,' or logs placed transversely, and, as if to emphasize the necessity of 'corduroying,' in the small patches that have been left open the mud attains a depth of from 2 to 3 feet.

Twice a week a launch leaves Hill's landing and tows five or six freight barges up the river to Porcupine lake. An enterprising French-Canadian has built several dams and locks by means of which the rapids in the river are passed. The journey up the river takes about five hours, and is certainly preferable to tramping eight miles through mud. From Hill's landing to Porcupine by the river route is 28 miles. Porcupine lake is due west from Kelso. The lake is about two miles long and half a mile wide; there are several settlements on its shore. The Porcupine 'townplot,' laid out by the Government, is on its northeastern extremity and on the right bank of the river. It is situated in low marshy ground and will eventually have to be abandoned. Another town-site has been laid out by the Porcupine Land & Development Co.; this is situated on the northern shore of the lake on the left bank of the river. It is well above the level of the lake. Here is the chief hotel, the Shuniah, as well as two banks, the post-office, and the most important stores. This settlement is generally known as Porcupine, but is also called Shuniah or Pottsville. The Shuniah is the rendezvous of all the mining men. It is always crowded, and twice a week, on mail-nights, all possible and impossible shake-downs have to be improvised to accommodate the numerous visitors.

A small settlement on the southwestern shore of the lake is called South End. This too is on low marshy land. It is the starting place for the mines in Tisdale, Deloro, and those further afield on the Mattagami river.

It is a remarkable fact that Porcupine has not yet been provided with any telegraphic communication. The absence of both a road and a telegraph point to lack of confidence in the possibilities of the goldfield as far as the Government is concerned. It is said that the roads will be all right when they are frozen and covered with snow, and may be used for four or five months in a year, but there cannot be any possible excuse for the absence of a telegraph. There was once a telephone line from Kelso to Porcupine; it never answered satisfactorily on account of numerous breakdowns, due to inefficient installation.

Most of the mines that show any development are situated in the township of Tisdale. They are the Dome property, owned in New York, the Timmins property, owned by the Timmins brothers, the Vipond and Connell veteran properties, the latter two either owned or under option in New York. The Consolidated Gold Fields of South Africa also has acquired an interest in the Connell veteran claims. The Dome property has been extensively and thoroughly sampled by Captain Anchor. It is said that diamond-drills have intersected the vein at a depth of 300 ft. vertical, and that the cores from that depth are rich in free gold. Gold in patches can be seen in numerous places along the quartz outcrop; it seems to follow small cracks in the vein, dark coloured and occasionally revealing the presence of small crystals of galena and zinc-blende. The main outcrops consist of two

THE SETTLEMENT OF PORCUPINE.

FOSTER LODE, SHOWING QUARTZ STRINGERS TRAVERSING DOLOMITE.

large quartz 'blows' or 'domes' and seem to indicate an orebody of lenticular shape. Disseminated through the country-rock of schistose structure, and close to the vein, are numerous crystals of iron pyrite, which is to be gold-bearing to the extent of 30 dwt. per ton.

The country-rock outside the mineralized zone has the appearance of a conglomerate: it is probably a re-cemented breccia in the Huronian formation.

One Nissen stamp is at work at the Dome and is exclusively used for sampling purposes.

In one of the Foster claims, west of the Dome, a large lode consisting of quartz stringers traversing dolomite has been exposed for several hundred feet. Except for stripping no mining work has been done. The quartz stringers show free gold in several places and the general body of the lode, which in places is 20 ft. wide, has well defined walls, of fine grained greenstone, belonging to the Keewatin formation. It is quite impossible at the present time to express any opinion as to the future possibilities of this orebody, on which the owners are spending money for exploration and sampling purposes. A feature common to all the lodes is the general absence of an appreciable oxidized zone; furthermore the country-rock does not exhibit decomposition either on the surface or when constituting the walls of a vein. Sulphides are to be observed even in the outcrops both of the veins and the country-rock. The general strike is 53° east of north and parallel with the longitudinal axis of the larger lakes.

The Timmins property is south of Gillies lake. Numerous outcrops of quartz, which may be grouped along five main lines, show free gold extensively. One of the veins has been tested in two places 600 ft. apart to a depth of 100 ft., at which level the two shafts are being connected by a drift, 300 ft. of which was said to be completed at the time of my visit. This vein is a well defined body five to six feet wide, going down almost vertically and showing free gold along the dark slickensides above mentioned. The quartz in the main workings has a more banded structure than the veins previously mentioned. One particular feature of the Timmins quartz vein is the presence therein of occasional feldspar crystals. The only similar occurrence was noted in the quartz on the Connell veteran claim, which appears to lie on the strike of the Timmins, although some 2½ miles distant. The Timmins property is equipped with a power station and two Tremayne stamps, which are said to be used for sampling purposes. The capacity of the two stamps may be taken at from 5 to 6 tons per 24 hours. The gold produced amounts to $12,000 per month; this, for 30 days' work, would indicate that the quartz is worth in recoverable gold from 3⅜ to 4 oz. per ton. It is, of course, doubtful whether it would be possible to maintain such high returns with a larger crushing capacity. The ore that may exist between the two shafts down to the 100 ft. level is estimated at 23,000 tons, which, at the rate of 3 oz. per ton, would represent a gross value of about £275,000. I understand that Timmins brothers have refused a cash offer of £300,000 and are asking over £1,500,000 sterling for their property.

These figures are mentioned to emphasize the utter hopelessness of doing any serious business as far as slightly developed property is concerned; but the terms asked for properties where merely a quartz vein is to be seen or even where nothing has been proved as yet, are similarly unapproachable. The prices asked for claims vary from about $15,000 to $350,000, the general terms being 10% cash down, another 20% after 60 days, again 20% after 120 days, and the balance after 9 to 12 months. No owner can explain why he asks $15,000 and not any other sum. The whole idea of purchase at the present time is regarded as a lottery gamble. It must be pointed out also that it is practically impossible to do any useful work within the first 60 days. Owing to the absence of telegraph, communications are necessarily slow and the state of the roads does not admit of bringing either supplies or machinery to a claim. This may be possible in the winter, but then again preliminary work, such as the construction of log cabins and other shelters, has to be done before any useful work can be started, and the first 60 days are over before there has been any chance of acquiring useful information. Yet some claims are being taken up on conditions as above stated, mostly by agents, who expect to deal with them in Toronto, Montreal, and New York. In a few instances light crushing machinery of small capacity is hurried to the claims under option. The small capacity admits of picked ore being treated with sensational returns, the object of such returns being too evident to require comment. These proceedings are particularly regrettable; they do not admit of real prospecting work being done, and prevent the serious investor from taking a share in the proper development of a goldfield which, generally speaking, possesses sufficient merit to enable the technical man to recommend systematic prospecting on a reasonable basis.

THE ELEMENT OF CHANCE IN THE SAMPLING OF ORES

By LEWIS T. WRIGHT.

IN the sampling of an ore a portion called the 'sample' is taken to represent the whole bulk. To perform this operation properly it is necessary to observe such precautions as will defeat unfair methods and control avoidable disturbing influences. If all the particles of ore were homogeneous or alike in grade there would be no need for precaution in the taking of any portion as representative of the whole. Any one portion or 'sample' would be like any other portion and equally and truly representative. But ores are more heterogeneous than homogeneous, and therefore in the taking of any representative fraction special precautions and apparatus are required to avoid a bias that may be either accidental and mechanical or intentional and personal. When these precautions are entirely successful in their aim the element of impartial chance is free to exhibit its capricious vagaries undisturbed by the influences of carelessness, trickery, or partiality. Chance, which is the operation of a cause or causes that we cannot predict or control, in the long run is impartial, sometimes leaning to one side, sometimes to the other, and by taking a sufficient number of results or chances the deviation of their sum from the true average can be made to balance within a small range of error. All that can be done in the matter of sampling is to mix and to take a portion. Mixing produces unevenness; an even mixture of different things can only be obtained by counting, sorting, and ranging them.

Perhaps the simplest way of demonstrating this unevenness, or deviation from the average, of a sample of mixed things is to take a sample of four cards from a shuffled pack. It may be a matter of indifference whether the four cards be taken consecutively from any part of the pack or separately from four different places. That has no influence on the average result. The average sample of one of each kind comes but about once in 40 times. The samples can deviate from the average up to four of one kind or a deviation from the true average of 300%. On making the samples ten times larger it will be found that the percentage of deviation though large is distinctly reduced. In a number of trials the greatest deviation from the true average of 10 of one kind was 18, or an error of 80%. Thus by making the sample 10 times larger the maximum error or deviation was reduced $3\frac{3}{4}$ times. On making up samples that should have contained 100 of a kind a sample with only 76 was found or an error of 24%. Here the maximum error was reduced 3 times by increasing the size of the sample 10 times. A well known formula much used by scientists for the calculation of the mean error of the mean of a number of observations which is based upon probability, implies that the error is reduced according to the square root of the number of observations. Thus by increasing the number of observations 10 times the error would be reduced 3·17 times. To reduce the error of 300% possible with the above samples that should contain one of a thing to a possible error of 1%, that is, to reduce it 300 times, we would have to take a sample of a size that should contain on an average 300 by 300, or 90,000 of that thing. It is easy to satisfy oneself that samples which on an average should contain 10,000 things may deviate 1% from the true average. This exemplifies the limits of the unevenness of impartial mixing of heterogeneous things. Impartial mixing is the basis of sampling.

This is the principle of the 'safe' weight of the sample. It is a question relating to numbers. We do not know the number of particles of mineral or of gangue or part mineral part gangue in our samples.

The question of what is a 'safe' weight of sample has to be studied empirically or by trial and the best way of doing so is to study extreme cases. In the following brief summary of investigations each individual assay, unless otherwise stated, was made on a portion of the ore-sample ground to 100 mesh or finer, commonly called the 'pulp' and weighing one-half of an 'assay-ton.' The assay-ton or A.T., for short, weighs 29,166·66 milligrammes and each milligramme of gold obtained per assay-ton represents one ounce of gold per ton of ore. The results are stated in ounces per ton, generally to the second, and more rarely to the third, place of decimals. The balance used in weighing the buttons is sen-

sitive to 0·005 mg., which corresponds to 0·005 oz. gold per ton, and the buttons are weighed to the nearest 0·005 mg. It is usual to make the fusions and assays on portions of ½ A.T., consequently the results reported in ounces per ton are correct so far as weighing is concerned to the nearest 0·01 oz. gold per ton, and deviations of more than 0·01 are due to other causes than avoidable errors in weighing. In commercial practice it is often agreed between the buyer and seller that differences of 0·03 oz. per ton or less shall not be disputed or submitted to umpirage.

In order to throw light upon the extent of differences arising in good assaying practice a mixture of sand and limestone of 100-mesh fineness was soaked in a dilute solution of gold chloride to compose an artificial gold ore of about 2 oz. per ton and of homogeneous content. The mixture was dried and calcined with the intention of coating each particle with a film of gold so that the particles should be as nearly equal in gold content as art could arrange. If the intention was successful then the vagaries of chance would be reduced to a minimum, and each ½ A.T. would contain well within the sensitiveness of the assay-balance the same quantity of gold, and the visible deviations between one assay and another would be due to error in assaying.

In the first set of six assays there were five of 1·92 oz. and one of 1·94. Here there was an extreme difference of 0·02 oz. per ton. In a second set of four assays two were 1·92, one of 1·94, and one of 1·91. Here there was an extreme difference of 0·03. In another series 10 results of 1·915 were obtained with one of 1·895, the extreme difference being 0·02 oz. per ton. Combining the 24 observations, the mean is found to be 1·918, with a mean error of ± 0·0017 and an extreme difference between observations of 0·045. It would thus seem that with a homogeneous ore a difference as high as 0·045 oz. per ton or a difference higher than the limits of good weighing can arise, due presumably to deviations in the assay operations other than those of weighing, between the highest and lowest results of a number of ½ A.T. assays. The extreme differences between individual assays of ½ A.T. found in the ordinary practice of sampling gold ores are very much greater than 0·005 oz. per ton.

If we want to study the magnitude of the element of chance as it affects the sampling of ores we cannot do better than to choose an extreme case, such as may be found among ores containing free gold, where the value of the mineral is high and the difference of specific gravity between it and the gangue is wide. If all the particles of gold in such an ore were free and distinct from the particles of the gangue and all the particles both of gold and gangue were of one size and that size were equal to 100 mesh, and the ore were of a grade of 1 oz. gold per ton, then in one assay-ton there would be approximately 4,000,000 particles of quartz or gangue and 21 particles of gold. Of course, no one would expect to be able to take out from a bulk of such ore of 100-mesh fineness various small portions that would always contain 21 particles of gold and no more or no less for every 4,000,000 particles of gangue. We are not wizards. We would naturally and instinctively expect considerable variations from the average number of 21 particles of gold per 4,000,000 particles of quartz. A difference of one particle would make an error of 5%. We could reasonably expect any number of particles, say, from 10 to 30 of gold, rather than exactly 21, neither more or less.

In most ores that have been crushed the valuable ingredient is chiefly in the fine and it is therefore likely that the average particle of mineral is smaller than the average particle of gangue. In other words, it is probable that in our samples there are more particles of mineral than there would be if the average size of the particle of mineral were equal to the average size of the particle of gangue. For this reason in our hypothetical ore, with all its gold free, there would probably be many more than 21 particles of gold for every 4,000,000 particles of quartz, because their average size would be smaller than the average size of the whole ore, but, relatively to those of quartz, the number would be extremely small and the chances of deviation from the average number in any one small sample would still be very great.

In this article I want to insist upon the element of chance, which makes it impossible for us to get an absolutely true average sample from a mixture of different things. We can only get a sample the deviation of which from the true average is negligible by taking a sample containing a sufficiently large number of the particles or things to be estimated. If, for instance, we had an average, as in the case imagined, of 21 particles of gold in a sample we would expect to get deviations of relatively great magnitude in different samples. By taking our sample so that on an average there were 210 particles, the percentage of deviation would be less, and so forth. In a general way

it is supposed that the percentage maximum deviation of a sample from the true average would be reduced 3·17 times by taking a sample 10 times greater.

To show the importance of these differences the first two assays of many 'pulps' of different gold ores containing free gold were noted. The average difference between the two assays of each of 24 *consecutive* samples of an ore marked (*B*) was 0·043 and included differences ranging from nothing up to 0·23, which was the maximum difference. Thirty-six sets of 2 assays of each of 36 *consecutive* samples of an ore marked (*A*) gave an extreme difference of 0·33 and an average difference of 0·05. Sixty-four sets of 2 assays each of 64 consecutive samples of (*C*) gave an extreme difference of 0·6 and an average difference of 0·068.

A gold ore known among assayers as being 'spotty' (that is, giving wide differences when assayed) in 12 assays gave an extreme difference of 0·345 between two ½ A.T. assays or a difference of 0·69 oz. on a total assay-value of 2·93 oz. per ton, a difference of 23%.

The evil effect of such large differences between individual assays can be neutralized by making a larger number of assays and taking the average of them. In the parlance of ore sampling, ½ A.T. is not a 'safe' sample of such ores.

Before discussing the question of weight as affecting the 'safety' of a sample of such 100-mesh pulp or one that with another of the same weight might only differ within the limits of good assaying, for example, 0·045, the mean of which would be 0·0225, it is well here to refer to a series of experiments made with the 'pulp' as delivered to the assayer. This pulp is commonly ground so that all of it will pass through a 100-mesh screen, and a great many experiments were made with such pulp along the following lines: First, could a method of mixing the pulp be discovered that would render the distribution of the gold more even than is indicated by ordinary practice? Could these extreme differences between ½ A.T. samples be reduced?

Second, and conversely, could the pulp be so handled by the assayer, on the rolling cloth or paper, within the limits of fair mixing or selection of the sample as to increase these differences?

Both of these lines of investigation failed to show that the extreme differences could be favourably or unfavourably influenced. The pulp was divided in every conceivable way. The ½ A.T. sample was taken in small portions from over 100 different parts of the bulk or as one portion from one part of the bulk. A stream of the pulp was cut a number of times by a miniature time-sampler and the ½ A.T. was composed of these cuts. The pulp was rolled in various ways, thought likely to be conducive to the segregation of its mineral or to its perfect distribution, though it is difficult to conceive how segregation could be induced by the slow rolling of a material the particles of which tend to cling to and lock into each other.

I shall not enter into the details of experiments made upon the finer grinding of the samples. The conclusion reached by those engaged in the work was that finer grinding was of no assistance in reducing the differences, and that as a size for the assayer 100 mesh or even less was practically as safe as 200 mesh. The results were always the same. It was as impossible to combat the element of chance as it would be in the case of different coloured balls taken blindfold from a bag or of cards dealt from a fairly shuffled pack.

There is a well known formula used by physicists and chemists for the purpose of calculating the mean error, plus or minus, of the mean of a number of observations. It is :

$$F = \frac{\Sigma\, d^2}{n\,(n-1)}$$

in which

F = mean error of the mean of all the observations.

d = deviation of each measurement from the mean.

$\Sigma\, d^2$ = sum of the squares of the deviation.

The satisfaction, if any, we get from this formula, is to learn that we can only reduce the mean error of the mean in the proportion of the square root of the number of observations. If we want to reduce the mean error of the mean to one-tenth of its magnitude we must take 100 times as many observations.

In the trials of pure chance, to which I have referred, and wherein the true average is known, the maximum error found was reduced somewhat less than in the proportion of the square root of the number of observations. In the case of our pulp samples, unless we assay the whole bulk, we are at the disadvantage of not knowing what the true average is. Some portion of the differences noted must be due to differences in assaying, but this latter source of difference has, relatively to the other, been shown to be small.

Given an ore that with samples of ½ A.T. exhibits a difference between the highest and lowest of 0·6, if we wanted to take samples sufficiently large to exhibit a difference no

higher than 0·06, we should (neglecting the possible but smaller error due to assaying details) have to make the weight assayed as high as 50 A.T. If by convention it were agreed that a 'safe' weight of sample should be one that did not differ from another sample of the same weight more than 0·06, we should have to make that weight for such an ore 50 A.T. This is 10 times as heavy as the sample usually distributed by the sampling works to the seller, buyer, and umpire. 50 A.T. would be the smallest safe division we could make of such a pulp.

Every time a sample is divided, and in the sampling operation it is divided many times, there may be an error, which will be important according to the number of particles of the sample and the character of the ore.

Having determined for an ore or class of ores the safe weight for a sample reduced to 100 mesh, can we then from this knowledge alone determine the safe sample-weight of any coarser size ?

volume of the larger size is greater than the volume of the smaller size could only be founded upon the assumption that the ratio of the number of particles of the richer mineral and the poorer gangue was the same in all the stages of the crushing of the ore from coarse to pulp and that during the grinding the mineral and the gangue were crushed at the same rate.

We know that the fine ore in any stage of crushing contains more of the valuable mineral than the coarse. The valuable component is chiefly in the fine ore. When the pieces of ore are 2 or 3 inches in diameter we do not find pieces of gold that are 2 or 3 inches in diameter, nor do we notice similar conditions in other smaller sizes. The particles of the richest mineral, namely, gold, in ores containing free gold, are in size obviously smaller than the other particles of the ore.

In the following experiment a gold ore was sized and the various sizes were assayed with results as stated :

Ore E.			Ore F.		Ore C.		
Size in mesh	Percentage by weight	Assay Oz. per ton	Percentage by weight	Assay Oz. per ton	Size in mesh	Percentage by weight	Assay Oz. per ton
On 8	69·88	1·72	62·41	2·02			
8 to 16	11·36	3·41	13·90	2·60			
16 to 30	6·70	4·29	9·33	3·74			
30 to 60	3·67	4·88	5·54	4·45			
60 to 120	2·75	6·30	2·25	6·34	60 to 80	15·8	0·44
Through 120	5·69	8·81	6·57	8·63	80 to 100	16·	0·49
					100 to 120	10·2	0·69
					120 to 150	4·6	0·90
					150 to 200	9·6	1·25
					Through 200	42·4	2·73
					Loss (dust)	1·4	
Calculated average		2·75		2·93			1·56

H. A. Vezin, who is identified with this question of the safe weight, having found that of the pyritic ores of Gilpin county, Colorado, one ounce or 1 A.T. was a safe weight for a sample that had passed a 20-mesh screen, for all other sizes larger multiplied this weight by a number that represented the number of times the volume of the largest sized particle was greater than the volume of a 20-mesh particle, that is, by a number proportional to the cubes of the sizes of the largest particles. Vezin's statement that the safe weights of another larger size than 20-mesh could be obtained by multiplying the ascertained safe weight of the 20-mesh size by the number of times the

Vezin's principle that a definite ratio between the weight of the sample and the size of the largest particles shall be preserved through the whole of the crushing operation is intelligible if the relation between the number of particles of the mineral and of the gangue remains constant, otherwise it would be purely arbitrary. If it has any merit it errs on the safe side because in the coarser sizes the proportion of the valuable mineral particles is, owing to their fineness, much greater that in the finer sizes.

His table, which applies particularly to the pyritic ores of Gilpin county, Colorado, is thus given in Hofman's 'The Metallurgy of Lead.'

Diameter of largest particle in inches.....	$\frac{1}{25}$	$\frac{1}{12}$	$\frac{1}{6}$	$\frac{5}{16}$	$\frac{5}{8}$	$1\frac{1}{4}$	$2\frac{1}{2}$
Minimum weight of sample in pounds.....	$\frac{1}{16}$	$\frac{1}{2}$	4	32	256	2048	16,348

This table starts with a sample of 20 mesh or $\frac{1}{35}$ of an inch, for which an assay-weight of sample of $\frac{1}{10}$ lb. or about 1 A.T. was taken.

It is difficult to think of any method other than that of actual trial for approximately deriving the safe weight of all sizes from the safe weight of one size as determined by trial. To construct a curve to serve for any size we want three points or the known safe weight of three sufficiently different sizes, at least, and the curve then would be true only for that ore or class of ore. For the ores discussed in this paper I had the opportunity of making a similar comparison between the contents of two samples of the same ore taken at $\frac{1}{8}$ in. and at 100-mesh, the latter being the size to which it is reduced before it passes into the hands of the assayer. In the sampling of these ores two cuts of from 50 to 100 lb. each were taken when the ore was of a maximum size of $\frac{1}{8}$ inch. According to the standard practice obtaining in the United States this weight of sample is considered safe for that size. The volume of $\frac{1}{8}$ inch is 11,737 times that of a particle of 100-mesh size. According to the practice recommended by Vezin, if 50 A.T., or 3·2 lb., were the safe sample at 100-mesh, then at $\frac{1}{8}$ inch we would have to take 373,584 lb. as a safe sample. In the following table is given the maximum and average differences noted between pairs of samples of different ores at 100-mesh and $\frac{1}{8}$ inch maximum size.

Ore	Difference between pairs of ½ A.T. assays		Difference between pairs of 3 A.T. assays including the equation of the two assayers		Assayers	Difference between pairs of 50-100 lb. sample weights at ⅛ in.	
	Maximum	Average	Maximum	Average		Maximum	Average
B	0·23	0·043	{0·124 {0·164	0·045 0·040	V and W V and X	0·195	0·034
C	0·60	0·068	{0·19 {0·19	0·049 0·050	Y and Z Y and W	0·395	0·060

It will be noted that generally the 50 to 100 lb. sample at $\frac{1}{8}$ in. is safer than $\frac{1}{2}$ A.T. at 100-mesh, both in respect of maximum and average difference. In this case the difference may be the result of the accumulation of deviations arising in different divisions of the sample, because in reducing the bulk of a sample at $\frac{1}{8}$ in. size to a few pounds of 100-mesh pulp it has to be crushed and divided successively into halves. This division is made six times. At each division a difference, large or small, is undoubtedly originated, and these differences may not always be neutralized by the next division, and thus the differences may be cumulative and not truly representative of the difference between the two 100-mesh portions taken at the $\frac{1}{8}$ in. stage. This is the difficulty that pursues the ore-sampler at every step and is particularly noticeable with special ores. If one half of the difference be attributable to an original difference at the time of dividing the $\frac{1}{8}$ in. sample, then for the ore (*C*) with a difference of 0·395, the weight of a sample to show no greater difference than 0·06 would be about 815 lb. If the whole of the difference is attributable to the same cause then the weight would be 3260 lb., a quantity immensely smaller than required by the old-fashioned rule of the cubes of the largest particles.

It is the practice in Western American sampling plants to distribute the samples of 100-mesh pulp in 5 oz. packages to the shipper, buyer, and, when required, the umpire. If a number of results obtained by different assayers are arranged in horizontal lines, each line containing the results found for the same ore, and if each assayer be given a separate column, we can compare both the work of the assayers among each other and also the natural unevenness of the different portions of the same 100-mesh pulp as divided and submitted to the different assay-offices. On adding the columns in corresponding groups of 10 or 20 horizontal lines we obtain the total results of the different assayers on corresponding samples. These totals generally harmonize, except for certain differences that are usually one-sided.

Thus, for example, on a number of results assayer W will be higher or lower than some other assayer by an amount that for each sample seems trifling though in the aggregate it may be quite important. This one-sided difference in the totals is distinct and characteristic. It may be called the equation of that particular assay-office and represents the sum total of the methods and persons involved in the work, and it may be large enough to be serious. If we examine the items in the horizontal lines we note differences sometimes

larger than is at all usual between the work of the best assayers, but these differences are not all in one direction; they are capricious, erratic, and impartial. These differences are mainly due to the natural unevenness of the ore.

To illustrate this unevenness of pulp, the assay-values of different portions of 5 oz. taken from the same bulk of 100-mesh pulp, of which 3 A.T. were used in each of the results reported by the different assay-offices, were compared and set forth in the following tables. They represent the average and maximum differences found between different assays, and for the purpose of intelligent comparison I give also the differences noted between pairs of ½ A.T. assays made in the same assay-office and also those differences noted between duplicate 50 to 100 lb. samples taken at the size of ⅛ in., all for the same lots of ores B and C, and from a large number of consecutive samplings.

If we turn back to the assays of an ore all of which was reduced to less than 60 mesh, given according to screen-sizes, we note that for such an ore when assaying 1·56 oz. the worst that art could do by screening, when dividing such an ore at that stage into two halves by weight, would be to get one half of an assay-value of 0·3 oz. and the other of 1·26 oz., or a difference between two samples of 0·96 oz. The perfectly mixed pulp at 100-mesh of similar ore yields differences between two ½ A.T. samples of 0·60 oz. That was the work of chance.

In order to see what would happen when 1½ lb. lots of ore of different sizes were divided over a single edge into two portions without any special care to avoid size separation the following results were obtained. One side of the dividing edge is called 'East' and the other 'West.' The samples were poured over the dividing edge from a shovel.

The number of experiments of this kind is far too small to determine maxima yet it is instructive. There need be no surprise at the

Ore	Average Assay Oz. per ton	Number of pairs	Difference between pairs of ½ A.T.			Difference between pairs of 50 to 100 lb. lots of ⅛ inch.		
			Maximum	Average	Max. Avg.	Maximum	Average	Max. Avg.
A	1·48	36	0·33	0·050	6·6	0 340	0·04	8·5
B	0·85	24	0·23	0·043	5·3	0 195	0·034	5·7
C	2·10	64	0·60	0·068	9·	0·395	0·060	6·6

AVERAGE ASSAY.—OZ. GOLD PER TON.

Size.	East.	West.	Difference.
½ to ¾ inch	1·18	1·64	0·46
½ inch	1·13	1·06	0·07
	1·14	1·13	0·01
	0·985	1·12	0·135
¼ inch	1·10	0·99	0·11
	1·12	0·99	0·13
	0·875	0·93	0·055
⅛ inch	1·32	1·58	0·26
20 mesh	1·48	1·435	0·045
	0·97	1·05	0·08
	1·05	1·03	0·02
	0·855	0·825	0·03
40 mesh	1·45	1·495	0·045
	0·99	1·00	0·01
	1·07	0·98	0·09
	0·81	0·795	0·015
60 mesh	1·36	1·88	0·52
	0·93	0·97	0·04
	0·98	1·00	0·02
	0·79	0·83	0·04
100 mesh	1·37	1·36	0·01
	1·03	0·98	0·05
	0·96	1·01	0·05
	0·82	0·795	0·025

difference of 0·52 oz. at 60 mesh. A very little experience with what are called "spotty" ores will convince anyone that with the best assaying larger differences than 0·52 can arise between ½ A.T. samples, crushed to 100 mesh.

The more we ponder on the assumption implied in the Vezin rule the more we are at a loss to understand its inception. It seems opposed to the instincts of a practical mind to imagine that this proportionality of the numbers of the particles of different things is going to be preserved through all the crushing of the ore from coarse to fine in all its stages. The general observation that the pieces of valuable mineral are generally smaller than the gangue should have discredited the idea that a fixed ratio between the weight of a sample and its largest particle should remain constant through all the stages of crushing.

To raise the matter of ore-sampling to a perfect art, the science of the unevenness of mixed things must be applied to its operations and, this being recognized, means should be taken so that the sampling operation can be checked within itself by the duplication of the sample at any of its many divisions.

THE DRAG-LINE EXCAVATOR

By J. POWER HUTCHINS

THIS new machine possesses many advantages over any placer-mining excavator except the floating dredge. While considerably inferior to the dredge it is far superior to the steam-shovel, to the clam-shell, the grab-bucket, or any other excavator under normal conditions.

The drag-line excavator is a comparatively new machine and was evolved in the course of excavating ditches and canals in the vicinity of Chicago. It consists of a car mounted upon wheels or rollers with a crane up to 100 ft. in length; this crane can be raised or lowered by hand or power, thereby regulating the height of the dump. On the end of the car opposite to the crane there is a boiler working at about 110 lb. This acts as a counter-weight to the crane. The engine, about 10 by 12 in., is geared to two drums, which are operated by friction-clutches actuated by steam, compressed air, or by hand. These drums are geared so that one gives slow speed and heavy pull to the drag-line while the other works the hoist line at faster speed. Two ropes lead from the two drums, namely, the hoist line to the end of the crane over a sheave and to a bucket, and the drag-line, through two 'padlock' sheaves on the end of the car to a chain-bridle on the bucket. The bucket may have a capacity up to 3 cu. yd. There is a sheave on the bail of the bucket and a short compensating rope that runs from the forward or digging end of the bucket over this sheave and out to the drag-line. A swinging engine works through a rack and pinion to rotate the machine through a complete circle or operates through cables like the bull-wheel of the swinging device of a derrick; in the latter case the crane cannot swing through 360 degrees.

The operation is as follows: by means of the brake of the hoist-line drum the bucket is lowered into the material to be excavated. The drag-line friction is thrown in and the engine started; the bucket is thus dragged toward the car and it fills exactly as a scraper does. Since the 1½ cu. yd. bucket weighs 3700 lb. and can be tilted by braking on the hoist-line drum and so tilting the digging teeth into the material, it excavates at a rapid rate even though digging 35 ft. or more below the track upon which the car is sustained.

When the bucket is full the friction-clutch is disengaged from the drag-line drum and engages the hoist-drum; the bucket is hoisted, the brake being kept on the drag-line drum slightly so as to keep the compensating line taut. By keeping this line taut the bucket is maintained in an approximately horizontal position and the excavated material does not fall out of it. The bucket is hoisted and swung simultaneously to the dumping point; then the brake is released from the drag-line drum and the bucket immediately takes a vertical position because it is articulated to the bail near the end opposite to the teeth, and the weight of the digging end plus the material in it make the bucket assume a vertical position. Thus a rapid discharge ensues.

This is the simplest type of bucket, and being easily described it has been selected from several for illustrating the working of the drag-line excavator-buckets in general. There are others with devices that give more or less freedom of loading and dumping, besides extending or limiting the radius of dumping.

The bucket above described can only be dumped at a point directly under the end of the crane. A drag-line excavator with a 1·5 cu. yd. bucket was installed last summer in Eastern Siberia by C. W. Purington for the Orsk Goldfields Ltd. on a pile of tailing resembling in shape the slag-pile at a smelter. It had an approximately level top 30 ft. above the bed of a creek, in which it was piled with an approximately oval outline. This tailing had been discharged from dump-carts pulled by horses. The excavator was placed on a track on top of the pile and a 2½ ft. sluice was installed on a grade of 8½ in. per 12 ft., or approximately 5½%, parallel to the excavator-track and 50 ft. distant from it. At the lower end of the pile the sluice was set 2 ft. below the surface; as work progressed and boxes were added to the upper end of the sluice it ran out of, and above, the ground and the head box was 9 ft. above the original surface of the tailing. For riffles we used 4 by 4 in. timbers and 12 lb. steel rails. Water was furnished, at first, by one 10 in. centrifugal pump and a gravity supply; later, by the 10 in. and a 9 in. centrifugal pump. This water-supply was, except after rains, inadequate and it was not possible to run the excavator at its top speed.

At first material was excavated from the

end of the pile and dumped into a hopper straddling the sluice and sustained on wheels resting on a track. The hopper was found unnecessary and was discarded; material was then allowed to accumulate on both sides of the sluice and thus formed sloping sides like a hopper. Even where the sluice was 9 ft. above the ground, this worked satisfactorily. The excavator was provided with a crane 60 ft. long and so made a cut about 115 ft. wide. Much of the time material was dug 30 ft. below the track.

The rate of digging was about 30 cu. yd. per hour, although water was nearly always scant and it was not possible to work at top speed. In the early stages of operation there was not enough water in the creek to supply the 10 in. pump constantly, so it was necessary to allow the dam at the pumping station to fill and to also allow the dam at the gravity supply to replenish. Later, a hydraulic-fill dam was made by running the tailing across the creek and, by discharging tailing above this dam, the water was returned to the pumping station so that we were able to run 24 hours per day.

Two men per shift were required to run an excavator: an operator and a fireman; three men were needed on the track and to tend the sluice and dump. From 5 to 6 cords of wood per 24 hr. were burned. Electric power has been used on drag-line excavators.

Among other advantages this excavator has a large radius of action; it can dig a cut over 200 ft. wide with a 100 ft. boom. It can be moved more easily than a steam-shovel, by dropping the bucket in the direction it is wished to move and, after removing the chucks, pulling on the drag-line. More than 50% of capacity can be obtained while moving by digging in a direction transverse to the line of track. The bucket is tight, so that there are no losses as with a dipper. It can excavate under water, and therefore is useful in exploiting wet creek-beds, where it can be employed in conjunction with a sluice sustained on a scow or a plant consisting of screen, tables, and stacker sustained on a scow. With either of these latter arrangements mobility hardly inferior to that of a floating dredge can be secured and a plant to have 1200 to 2500 cu. yd. capacity can be installed for about $15,000 to $40,000 in most of the known placer regions.

It is planned to use the excavator now in Siberia in conjunction with a screening, sluicing, and stacking plant on a small tract of ground not large enough to warrant the installation of a dredge. The excavator will run on tracks laid on the surface of the ground, backing away from the excavation as work goes on. The scow, with its plant, will float in the pond and follow the excavator; one spud at the bow in the median line of the scow will prevent surging during high winds. Two bow-lines lead aft and two stern-lines lead forward, in each case to dead-men on the bank. Two gangways will extend from the sides to permit wheeling wood aboard from either bank. The tailing can be distributed across the full width of the 120 ft. cut, if desired, by moving the scow laterally or by allowing it to pivot on the spud so as to swing the stern.

A similar plant with a sluice, boiler, engine, pump, hand-winches, electric-light plant, complete but without screen, tables and stacker, with excavator to handle 1200 to 2500 cu. yd. per day, can be installed for £15,000 to £30,000 in most of the known placer regions.

The above described plant has never been tried, and indeed the drag-line excavator has never been used before in placer mining. There are areas in the far north where it can probably be applied advantageously, in excavating alluvium, like the steam-scraper used in open-cut work in the Klondyke district. As the surface thaws on exposure to sun and air, the material can be scraped off and another layer of frozen material exposed to thawing. A limited volume of gravel may not justify the heavy expense for a dredge; such a property can be equipped cheaply with a drag-line excavator and a sluicing-plant. There are also small areas not contiguous but adjacent that cannot be worked by a dredge; upon such as these the drag-line excavator can be operated, for it can be moved from place to place rather easily. One with an 85 ft. boom is said to have been moved one mile in 10 hours.

Other applications for this type of machine will suggest themselves. It is likely that the drag-line excavator will be used to perform some of the work that the steam-shovel is now doing in general excavation. While it is a new machine and, like all new machines, in process of evolution, it is already efficient. In comparing it with a steam-shovel, several disadvantages are obvious. It will not excavate hard material; it will not handle stumps readily; but these failings are largely due to a lack of power in the drag-line pull of the machines as yet built. It is certain that these defects can be remedied by designing more powerful drag-line machinery, but it is unlikely that a scraper no matter how powerful can excavate indurated material as successfully as a steam-

shovel. The drag-line excavator cannot discharge into cars as readily as a steam-shovel, for it cannot 'spot its dump' so accurately.

It is interesting to note some of the ways in which a drag-line excavator may be used. It can work in all the combinations in which steam-shovels have been employed in placer

Bucket dumping, showing operation of compensating line.

mining, and in addition it has the advantage of being able to dump material 20 ft. or more above the track upon which it is sustained.

Drag-line excavator on tailing pile in Siberia.

In addition, the excavator is on top of the ground and not, as the steam-shovel must necessarily be, on bedrock in the bottom of the cut. Thus in some instances it may be possible to get sufficient grade for sluices and dump for the tailing because the excavator is on the surface of the ground and is able to dump 20 ft. or more above the ground.

Assuming that a deposit of gravel 20 ft. deep is to be exploited either by a steam-shovel or an excavator, let us ascertain what will be the repective heights of dump for the two machines. The steam-shovel rests on bedrock

Three branch tailing sluices, excavator, and full dump.

and can dump about 10 ft. above that bedrock. The excavator rests on the surface of the ground and is therefore 20 ft. above bedrock;

Scraper-bucket being dragged and loaded.

it can dump 20 ft. or more above its own track. Thus the excavator can dump 40 ft. or more above bedrock or at least 30 ft. higher than the steam-shovel. The deeper the gravel the greater is the difference in favour of the excavator.

The steam-shovel has been used to dump

into a sluice, into cars, into a hopper, on to a belt-conveyor. The drag-line excavator can do all these operations and do them better, while excavating a cut many times the width possible to dig with a steam-shovel. In addition to doing all that a steam-shovel can do, it can dig under water, so that a screening, sluicing, and tailing plant can be floated on a scow and follow in the cut made by the excavator while digging under water from its setting upon track or rollers on the surface of the ground. Thus stream-beds impossible to work by steam-shovel on account of wet ground can be exploited profitably.

At present the drag-line excavator does not work as well under water as when working in dry ground. It has been said that the reason is that the buoyant effect of the water on the bucket hinders excavation. While there is some truth in this, the real reason is that the drag-line pull is usually not powerful enough to drag the bucket with sufficient force to fill it heaping full. There must be an excess of power to fill the bucket just as there is an excess of power on the dredge. Until the several manufacturers of drag-line excavators shall design and construct machinery and buckets to pull harder and stand harder work, respectively, there will be complaints as to the difficulty of digging under the water. But when the drag-line pull has been increased and the bucket has been strengthened so that it can be dragged into the material until it is heaping full each and every time, there will be no further complaint.

The detailed figures concerning the cost of the East Siberian operation will be of interest, as will the results of the scow-plant now nearly completed on the property of the Orsk Goldfields.

The Price of Zinc.—An interesting review of the zinc market appears in the issue of the *Engineering and Mining Journal* for October 22, and the prospects of the market and of the price of the metal are discussed at length. The European position in the zinc market is fairly well understood, the chief factor being the Convention among European smelters, a convention which has worked remarkably well. In the United States the tendency toward high prices is due to the fall in the production owing to the exhaustion of natural gas supplies on which nearly two thirds of the output has depended for the last 10 years. The production of zinc in the United States during 1909 was 266,462 tons of which 157,998 tons came from smelters in Kansas and Oklahoma using natural gas, and 108,464 tons from places where coal is used. In parenthesis we may note that the sulphur of 108,464 tons of zinc was recovered as sulphuric acid. Owing to the exhaustion of the natural gas at Iola and other smelting centres in Kansas many works have suspended operations and more will follow. Before the new works situated in the Illinois coalfields have got into operation the production will fall away. Our contemporary estimates the production during 1910 in the United States at 250,000 tons. As regards consumption the figure for 1909 was 262,000 tons, and at the present time the rate is not quite so high so that stocks are accumulating to a small extent. This fall in consumption may be only temporary, but in any case within the next few months the further fall in production will more than balance this slight reduction in the consumption.

Arsenic and Safety.—A few years ago the United Alkali company introduced a wet method of removing arsenic from sulphuric acid produced from impure iron pyrite. The inspector under the Alkali Act reports that this and similar processes are now at work at 15 sulphuric acid works in Great Britain. These processes are important nowadays when so much starch is saccharized by acid; and, also they make it possible to produce pure acid from poor quality pyrite. In the United Alkali process, the sulphuric acid is first brought into contact with a reducing agent in order to bring the arsenic to the arsenious state and exposed to the action of dry hydrochloric acid gas. The result is that arsenious chloride is formed. This being an oily liquid most of it can be separated by settlement. In order to remove the remainder air is blown through the acid; the chloride comes away as vapour, and on being brought into contact with water in a scrubber is decomposed into arsenious and hydrochloric acids.

Refining Tin.—A wet method of refining impure tin is described in British patent 16,053 of 1909 granted to G. de Bechi and F. C. Blythe. The ordinary method of dissolving the tin by hydrochloric acid is never complete, as the other metals present cause the reaction to be arrested. The inventors continue the process from this point by adding perchloride of tin which dissolves the remaining tin and yields stannous chloride. The tin is then precipitated by zinc in the usual way. The perchloride is formed by oxidizing stannous chloride by air in presence of an excess of free hydrochloric acid in an oxidizing tower.

THE SUPPLY OF IRON

By JAMES F. KEMP.

*THE plan of preparing an estimate of the world's resources in iron ore has had the cordial support of the Prime Minister of Sweden and it is a pleasure to acknowledge our indebtedness to him. The plan has been ably carried out by the Swedish Committee, and special acknowledgments are due to Dr. J. G. Andersson for the able way in which the difficult task of editing has been performed. As a result we have before us a work which will furnish much food for economic speculation and thought. When we try, however, to project ourselves into the future, we soon find that we are not able to speak with the accuracy of mathematics, but we must be content with the attainment of conclusions which, within certain limits, are not unduly remote from the truth. The subject is a complicated one, and may perhaps be best discussed after the mathematical form of assuming, so to speak, an equation which is a function of several variables. By taking one variable at a time and following out the effect of its changes upon the general function, we may, by a series of approximations, in the end establish a solution worthy of confidence.

The future of the iron industry is a function of the following and perhaps of other variables:

1. The increase in annual production which will make greater demands on the reserves.
2. The decrease of some of the present sources of supply and their final exhaustion.
3. The entrance of new sources of supply now perhaps inaccessible.
4. The gradual decline in average content of iron in the ores used.
5. The increase of expense of production with declining yield.
6. Improvements in existing processes which reduce expenses.
7. The supply of fuel; above all, under present circumstances, of the coking coals.
8. The entrance of new methods of smelting, especially those depending on electricity.
9. The substitution of other materials for iron and steel; among which cement is most important.

We, delegates to the Congress, who have come across the ocean, have gazed with profound interest upon the collections in the National Museum which so graphically portray the history of the Scandinavian peoples from the Stone Age, through the Bronze Age, into the Iron Age. It is the Iron Age, which many people believe to be the one in which we live. This belief is only partly true. We really live in the Age of Steel, not of Iron, and it is very important that we should so regard our own times. Almost all the pig iron produced is used in the manufacture of steel. In the United States, whose output of pig iron the past year was over 25,000,000 tons, and was more than that of the next two nations combined, approximately 90% of the yield of the furnaces is marketed in the form of steel. This ratio will probably continue until we pass from the Age of Steel into that next age of the human race, the Age of Cement, a period which already looms above the horizon and which bids fair in no unimportant way to prolong the life of our iron ore reserves. For many structural purposes re-inforced concrete has already replaced steel and has even been used in the construction of ships.

The report on the iron ore reserves makes it clear that there will be no exhaustion of iron ore of one kind or another for an indefinite period of time. If we consider iron-bearing materials of 30% as ores, there is no lack of a supply for our furnaces. Much apprehension has been felt on this point and it is reassuring to find our fears in a measure unwarranted.

Iron, as a metal, of course, never can fail, for if we drop to 20 or 10%, we find inexhaustible amounts of basic rocks with these percentages, and we are then dealing with raw materials from three to ten times as rich in iron as are the usual copper ores in copper, the next metal to iron in abundance of production.

But the existence of iron ores of even greater yield than 30 to 40% is one thing, and their availability under ordinary conditions of smelting is another. Iron must be produced at low cost if it is to continue to fill its present place in modern civilization, and thus the sources of supply are restricted to comparatively few regions. Almost all the iron and steel of the world is now produced in Western Europe and Northern America, roughly about 60% in the former and 40% in the latter. In North

*A contribution to a discussion before the International Geological Congress, at Stockholm, on August 22, 1910. By courtesy of the Author.

America the industry is almost all in the eastern part of the country, whether it be in Canada or the United States. If, therefore, we consider the actual facts of production, we necessarily restrict ourselves to a comparatively small part of both Europe and North America. Again, if we consider the population of the world at large, and the population of the countries that produce the iron and steel, the latter is a small fraction.

When therefore we speak of the world's reserves of iron ore, if we have in our minds the entire surface of the globe, we are discussing a matter that is largely of academic interest. But if we come down to the business of producing iron and steel as an economic matter, we must eliminate from consideration as affecting the large features of the immediate future all but that small part of the world that lies in western Europe and eastern North America.

What then is the outlook in these larger producing areas?

Of the United States I can speak with most intimate knowledge, but they are far removed from the countries of Europe, and the iron industry has not yet developed international features except in the importation of ore. The larger features of its future can be summarized in a few words. There are two principal and several minor sources of supply; the Lake Superior region and the Alabama region comprise the former; the Appalachian mountains almost all the latter. The Lake Superior region furnishes four-fifths of the American ores, and one state, Minnesota (whose chief population is of Swedish parentage), supplies more than one-half. The ores are low in phosphorus and sulphur, relatively high in silica, and are very cheaply mined. The ores formerly yielded 60% and over in iron. Now they average somewhat over 50%. At 40%, which is still comparatively high, considering the world at large, the amount is inexhaustible. The ores are transported from several hundreds to over one thousand miles in order to meet the coke and be smelted to the best advantage.

In Alabama, and to a less degree in neighbouring States, the ores formerly yielded from 40 to 50%, but the most important variety has now settled down to about 37% a yield which will not essentially change for many years to come. The ores thus are comparable with the minettes of Germany and France. The coal, the limestone, and the ore are all within a few miles of each other, so that the low cost of production is not equalled elsewhere in America. The ores were silicious in early times, when they were obtained near the surface. In depth they have become basic. They are stratified and can be estimated as accurately as coal-seams. The ores are moderately high in phosphorus, much above the acid-bessemer limits. Other sources of supply contribute lesser amounts of ore in the Alabama region, and still additional sources are found along the Appalachian mountains, but the chief producers have been reviewed above. The reserves are sufficient for many years to come.

West of the Mississippi the iron industry is relatively small; one moderately large plant is in operation at Pueblo, in Colorado, and another is just being completed on Puget Sound. The development of Alaskan coal will be an important factor in the future.

The most interesting feature of the next few years will depend upon the development of the new supplies of ores from the northern side of Cuba. Great deposits have been proved by the drill. They lie upon the surface and will be cheaply mined by steam-shovels. When calcined and freed of their abundant moisture they will supply an ore above 40% in iron, almost entirely free from phosphorus and sulphur, but containing chromium and nickel oxides. The anticipation is entertained that they will greatly revive the steel industry on the Atlantic seaboard, if they do not also lead to the construction of new and extensive plants.

In America, therefore, so far as ore is concerned there is no prospect of serious change for an indefinite period. America has been a relatively new country of great distances. Means of transportation calling for steel have been absolutely essential to development. Steel is now employed also in enormous quantity for structural purposes, since all large buildings—the 'skyscrapers'—have a framework of steel; but cement is being more and more utilized and will probably in time affect the consumption of steel in no unimportant way.

Aside from America, in particular, I can only speak of the iron industry in general terms.

In forecasting the future the first disposition is to divide the tons of reserves by the annual production and thus estimate the life of the mines. I am, however, reminded that in the last fifty years the production has increased by leaps and bounds, as Mr. Van Hise made clear in his address at the opening of the Congress. This rapid increase is true not only of the United States but especially in later years of Germany. An element of uncertainty is

thus introduced into the first simple calculation and the life of the reserves is correspondingly shortened.

On the other hand, in the older iron-producing countries the railways are now built; the great public improvements are largely completed, so that for these purposes the supply of iron or steel is not now required. The iron, moreover, already in the metallic state steadily accumulates for re-working. We cannot anticipate the continuance of the geometric rate of increase. We are more likely to attain a fairly stable annual output. Just what this production will be, it is difficult to state, but the supply of fuel of which I shall speak in a moment is an important factor.

Undoubtedly some of the present sources of supply will decrease and finally will be exhausted. Of this feature I am inclined to speak with reserve because most of us have thought that the iron ores of England and the Bilbao ores in Spain were approaching exhaustion, whereas we have learned from the reports to the Congress that new reserves have been opened up by further exploration; the Bilbao ores, for example, can scarcely be regarded as nearing their end, as over sixty millions of tons remain to be utilized. Nevertheless there are doubtless some present producers which before long will cease to ship. For the furnaces thus deprived of their old sources of supply, new ones must be found. Apparently in these relations Sweden, Algeria, Newfoundland, Cuba, and Brazil will come more and more to the front. Assuredly there is a future of increasing importance for the exporting countries. Nevertheless as local sources of supply decline we must anticipate tariffs and legislation looking toward the conservation of natural resources; these will operate to postpone exhaustion. There are thus antagonistic influences which must be balanced in any forecast worthy of confidence.

In some important producing areas, especially in the United States, a gradual decline in the average percentage of iron in the ore is inevitable. The decline is most marked in those countries where the richest ore has been naturally the first to be utilized. But the percentages, although lower than those hitherto available, will soon be fairly stable in America, and they have already practically reached this condition in Germany. Changes will then only be apparent over long periods of years. With the lowering of percentages, and an amelioration of the conditions of production, a wider range of ores becomes available, so that lowering is checked. There is thus a delicate and interesting balance maintained by these influences.

With the lowering of the percentage of iron in the ore, the cost of production naturally increases. More barren material passes through the furnace, with decreasing product, and increasing expense for fuel. From this cause alone one might infer a decrease in output. But, on the other hand, improvements in processes of smelting have from time to time appeared and have more than neutralized these effects. In the United States, for example, furnaces have grown enormously in size and capacity. The recent invention of my countryman, James Gayley, has tended greatly to increase the efficiency and the uniformity of operation. Mr. Gayley passes the incoming air of the blast through a series of coils, cooled below the freezing point of water by a very cold solution of some salt such as calcium chloride, so that all the moisture is chilled from the air which then enters the stoves in a thoroughly dried condition. The accumulated moisture, frozen to the coils, can, when necessary, be melted off by the outgoing heated gases, while the incoming air traverses a second cold chamber. By such an improvement as this or by others likely to be made as time goes by, the effects of decreasing percentages have been offset and again a delicate and interesting balance of opposing forces has been established.

Let us now assume that essentially the methods of smelting which are practised today will remain in force for a long period of years. The iron ore goes first to a blast furnace in which, in the vast majority of cases, it is reduced by coke to pig iron. Roughly speaking one ton of coke is required to produce one ton of pig iron. For the one ton of coke about 1½ tons of raw coal are necessary. If our ores yield 50 per cent. in iron, then for each two tons of ore 1½ tons of coal are utilized and that coal must possess superior qualities in order not to crush down under the heavy burden of a modern blast furnace. In so far as the future of the iron industry is concerned, the serious question is not alone the supply of iron ore but also the supply of coking coal. It will not suffice in these relations to say that this country or that has so many thousands of square miles or kilometres of coalfields, because only a relatively small part of the coalfields yields the right sort of coal. We must know how much of the latter the world possesses and then how much of this supply is near enough to blast-furnaces to be utilized without excessive transportation. The coal

supply would seem to me to be the next question which a future International Geological Congress might most appropriately take up. Not until these data are at command can the remoter future of the iron industry be suitably forecast.

But we may ask, are our present methods of the reduction of iron destined to continue? To this it may be replied that with the present outlook electric smelting alone seems likely to introduce changes and so far as it can be employed only to the following degree. In the reactions of a blast-furnace about two-thirds the fuel is employed in supplying the necessary heat and one-third in the reduction of the iron oxide. Electrical energy, supplied by water-power, may replace the two-thirds of the fuel as a source of heat; the remaining one-third will always be necessary. In countries where there is abundant and practicable water-power, electric smelting may thus be feasible. Charcoal may even in some furnaces entirely replace coke, over which, being a purer source of carbon, it has manifest advantages. Poor charcoal such as may be obtained from refuse lumber may perhaps suffice, so that to some extent the demands upon the coking coals may be reduced and the life of the reserves may be prolonged. Obviously in countries such as England, with limited water-power, but with great supplies of coking coal and great iron interests, electric smelting can be of small importance except in so far as it may enable other lands, such as Scandinavia, to export to it some supplies of iron, necessarily furnished at sufficiently low cost. Electric smelting is in its infancy as yet, but it is of sufficient promise to deserve mention as a possibly important factor in the future.

The final variable in our function which calls for brief mention relates to the substitution of other materials for iron and steel as time goes by. Of these cement seems to be the one of most serious moment and only in so far as it may supplant structural steel. In the form of reinforced concrete cement is a material which grows in favour and in use. Some steel is of course used in its manufacture and the cement is thus only in part a substitute, but its potentialities are sufficient to justify its mention. No one can accurately estimate its future influence.

In conclusion I may repeat that the subject is complex. That the future of the iron industry is a function of a number of fairly independent variables is clear. Some of the variables neutralize each other. Some of the variations we cannot fully trace. On the whole, for many years to come, I believe the iron industry will continue without any very fundamental changes.

Canadian Iron Ores. — Interesting information comes from Canada with regard to the development of the iron ore resources. A recent visit of inspection to the Moose Mountain Iron mines, north of Sudbury, Ontario, by John W. Gates, of New York, and several other directors, has resulted in the decision to increase the output of ore from 400 tons per day to 1000 tons. The larger amount can easily be handled by the present plant, but an additional force will be engaged and another mine opened. The ore is shipped from Key Harbour, a new port on Georgian Bay, to Cleveland, Ohio, where it finds a ready market. Mackenzie & Mann, of Toronto, have secured 4400 acres of iron ore deposits at Grand Rapids, on the Metagami river, in Northern Ontario, being practically all the exposures of ore in that neighbourhood. They will put five diamond-drills to work at once to determine the depth of the deposit. The ore is of excellent grade and the United States Steel Corporation were anxious to secure it, but were outbid by the Canadian firm.

Nickel-Copper-Iron Alloys.—In United States patent 965,871 G. H. Clamer describes a process for producing a nickel-copper-iron alloy direct from sulphide ores containing iron, nickel, and copper. The ores are smelted in the usual way to produce matte. This is then bessemerized in order to reduce the iron to the right proportion and afterwards roasted for the expulsion of sulphur. The mixed oxides are then smelted with carbon and the alloy produced. The quality of the alloy depends on the amount of carbon present. The composition of the alloy may vary from 25 to 50% nickel, 5 to 20% copper, and 30 to 70% iron. The alloy is said to be similar in character to nickel steel.

Precipitation of Gold by Charcoal.—Thomas Edwards, of Ballarat, describes in United States patent 967,744 a vat for continously precipitating gold from cyanide or chloride solutions. The vat consists of a series of compartments containing vertical partitions with spaces alternately at the top and bottom through which the solution can flow. The vat is filled with charcoal in small pieces, and perforated covers hold the charcoal in place and allow the solution to pass. It is claimed that this apparatus is much more rapid and cheap than is usually associated with charcoal precipitation.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Mining in Siberia.

The Editor:

Sir—During the past year there have appeared several articles in *The Mining Magazine* and the *Mining and Scientific Press* with reference to mining conditions in Northeastern Siberia, and to the Northeastern Siberian Company, Ltd., of which I was for years one of the managing directors. Statements have been printed to the effect that the Russian Government violated its agreement with the company and confiscated the company's gold; also that the company, itself, in place of carrying on mining operations, was more particularly active in whiskey-trading with the natives. Both of these statements are wholly untrue.

The company's concession covered an area of over 60,000 square miles, absolutely unknown as to resources, or topography. To carry on prospecting for minerals and other development work in such a large, unknown and inhospitable territory without several bases of supplies would have been futile, so our first task became the construction of four supply stations. Upon our arrival in this territory, we found the natives in the most miserable condition of poverty and disease, largely the results of intercourse with the whaling ships. We decided to try to remedy this state of affairs and in the course of six years we brought to these natives over 1,000,000 rubles (£100,000 in value) in flour, sugar, tea, biscuits, tobacco, lumber, whaling boats, all classes of tools that could possibly be used by them, thousands of Winchester rifles and guns, as well as several classes of dry-goods and wearing apparel, also stoves, clocks, lamps, sewing machines, phonographs, etc., etc., and less than one-half of 1% of our importations were alcoholic beverages. The result of our operations was to change the conditions of the natives from starvation and disease to comfort and health. The truth of this was, and is, too self-evident to be disputed by anyone, except persons disposed to commit deliberate falsehoods.

As for mining: the records and maps show, and fully establish, that we carried on continuous exploration over the whole of this large territory, even during the period of the Russian-Japanese War, and at a cost of several hundred thousand dollars, and these explorations resulted in the discovery by us of gold, both in placers and quartz, also silver, lead and copper ores, iron ores and graphite, and our years of operations changed it from an unknown to a known territory. The story of the Russian Government confiscating gold is based upon a clumsy overt act of one of the company's own directors—one Mr. Kovanko, of St. Petersburg, who took, in a rather disagreeable manner, about £2000 in placer gold from the foreman of a sub-contractor. The Russian Government had no part in this transaction. On the contrary the ministers of the Russian Government, by words and deeds, invariably displayed strong desire to aid in developing the concession territory.

My seven years of experiences in connection with Siberian development are far from satisfactory, but it was not lack of resources in the concession territory, or unfriendly acts on the part of the Russian Government that produced such results.

JOHN ROSENE.

Seattle, September 28.

[We are glad to publish this letter. Mr. Rosene is well known as an intrepid explorer and energetic promoter. It is a pleasure to know that he was not hindered or harassed while conducting exploratory operations in Siberia.—EDITOR.]

Crushing by Stages.

The Editor:

Sir—As an advocate of stage-crushing, it is with satisfaction that I note the interest which this important branch of the metallurgical engineer's profession is eliciting from all quarters of the globe. In 1897 I substituted ¼ in. screens for the 20 or 30-mesh screens generally in use at that time in stamp-batteries. The product of this coarse crushing was passed to Huntington mills for final reduction. By this method with 30 stamps of 850 lb. each and 8 Huntington mills a capacity of 200 tons per day was obtained, instead of the former capacity of about 60. The principle was right but the method was discontinued for a time owing to the repairs required by the Huntington mills. Later this system was again adopted with ½ in. screens and today it is a positive success.

In recent issues of *The Mining Magazine* and the *Mining and Scientific Press* articles have appeared upon this subject by Messrs. Caldecott, Way, Cramer, Del Mar, with editorial comments. In an editorial in the June issue of *The Mining Magazine* I note the statement that we are all merely learning the elements of crushing efficiency. The truth of this statement is forced home upon us as we go

more deeply into the subject. Simple as it seems, we learn how little we know when we study the subject. Stamps are being made heavier and heavier, but the area of the die is not increased proportionately. This, I believe, is one of the greatest errors; and another is the fact that there is no automatic clearing of the surface of the die. It appears to me that the heavy 2000 lb. stamp is encroaching upon the function of the rock-breaker, for energy is consumed in raising the stamp whether or not it drops upon freshly fed material or delivers subsequent blows upon a mass that, as suggested by Mr. Way, should be crushed by a lighter stamp. With a 1000 lb. stamp, delivering its blow at the rate of 100 drops per minute upon 2-in. cubes of ore weighing $\frac{3}{4}$ lb., and reducing them to a mass the average size of which will be less than cubes of $\frac{1}{4}$ in., we can obtain an output of 54 tons per stamp per day instead of one-tenth of this capacity when the crushed mass is allowed to remain under this stamp for further reduction. If this crushed mass were at once removed to a lighter stamp proportioned to the work to be performed the subsequent stamp would be of a weight of only two pounds, inasmuch as the 2 in. cube has undergone a division of 512:1. We can give no satisfactory reason for continuing to deal 1000-lb. blows except that we have no means of removing the product from the die. Not only is it a mathematical but an economic fact as well that these $\frac{1}{4}$ in. cubes are subject to an equal division as was the original 2 in. cube by a blow equal to the mass-resistance, for the crushing-resistance of a body is proportionate to the particles contained. This being a fact, the next size of stamp in the series required would be one of 2 lb., hence 'serial' stamps are out of the question. This theoretical reduction of 1000 lb. down to 2 lb. is out of mechanical reason or proportion, tending to show that the stamp itself is as economically ineffectual as is a reduction of 500 : 1 in one operation. Hence I believe that Mr. Way has taken a step in the right direction when he adopts 4 meshes to the square inch, $\frac{1}{2}$ in. holes, less wire, and makes his crushing division thereby 64 : 1. Even this is too great for economic division, and I would go a step farther and use a screen having apertures of one square inch. Then the theoretical division would be 8 : 1 and the smaller stamp would be 112 lb. I would not obtain this division by stamping, for it is as impracticable, owing to the mechanical difficulties involved, as the 500 : 1 division. A crusher will perform the work required more rapidly and economically, hence I would not employ any stamp at all, for the reason that a stamp of 112 lb. is still of a greater weight than is necessary economically to crush the 1-inch cube, and the area of the shoe and die would be immensely disproportionate to the economic requirements.

It is the clean hard surface that performs the work. This can be obtained by using a 4 in. iron ball weighing about 10 lb. with crushing surfaces of 50 sq. in. or five inches of surface for each pound of weight, instead of 10 lb. of weight for each surface inch of shoe and die combined in a 1000 lb. stamp. "We have been using stamps for years, a hundred years or more," is a reason that has been given for continuing the practice. A hundred of these balls will equal the weight of the 1000 lb. stamp with approximate shoe and die surface of 100 sq. in., while the balls have 5000 sq. in., a crushing surface of 500 : 1 in favour of the balls. This is the secret of their greater efficiency. The stamp consumes $2\frac{1}{2}$ h.p. while the balls in a properly constructed mill will require 5 times this power but will have 20 times the efficiency.

My method of solving this difficulty is, as you are aware, to use heavy balls at the largest diameter of a conical ball-mill and a proportionate number of them at the point where the largest particles of material enter the mill, the diameter of the balls and the amount of fall gradually decreasing, as well as the peripheral speed, all tending to effect the theoretical results desired in graduated stamps. I have also learned from experience that the capacity of any crushing device is increased when it is crushing material that is coarser than any size issuing from the outlet of the machine, and that therefore any particle fine enough to pass through once should not be returned to the same device as over-size, but sent to a finer crusher if possible. Especially is this the case with stamps, as is proved by the common practice of screening the finer particles through grizzlies; for when the fine is fed to the stamps, the capacity is retarded in direct proportion to the amount. This does not alone apply to stamps but even to rock-crushers, and more particularly to tube-mills. I have found that I can obtain a larger percentage of fine by feeding material as coarse as 6 to 8 mesh to a pebble-mill than when the 'feed' contains material of a size already considered finished, for the latter acts as a cushioning interference. In this I am only repeating the experience of Mr. Smart as given in the June issue of *The Mining Magazine* describing the action and results in the use of the Caldecott classifying cone; he shows a larger capacity in tons and a finer ultimate grinding when a larger percentage of better

classified coarse material is fed to the tube-mill. It goes to show that the cushioning effect of fine material and the obstruction of crushing surface is the cause of a decreased capacity, even when credit is given for the sufficiently fine material that passes through the machine without further reduction.

H. W. HARDINGE.

New York, October 15.

Calculation of Percentages of Recovery.

The Editor:

Sir—The article by Mr. T. J. Hoover, appearing in *The Mining Magazine* for August, on 'Calculations of Percentage of Recovery,' was read by us with considerable interest, as was also the editorial in your August issue referring to these methods of calculation. The only objection to the editorial is that it makes it appear that these methods of calculation are quite new. Such an assumption, however, is an error, and it is our opinion that a number of mill-men are aware that their operations can readily be checked with a close degree of approximation by an outsider.

Weights are not necessary where it is simply a matter of three items: ore, tailing, and concentrate. When, however, as in more complex milling (which is becoming more common from year to year), there are not only three but four or five products to consider, among all of which the metals to be recovered are distributed, the calculations, on the basis of assays only, are more difficult. This is true where it is desired to obtain a record of the work of a concentrator that is separating lead, zinc, and iron, and, besides a tailing product, makes iron, zinc, and zinc-silica middlings.

While it is true that many mill-men have no idea of the value of simple algebraic equations in checking their work, we do, however, believe that ignorance of this method is not as common as might be supposed. We have been using this method for a number of years, and could recite some laughable instances where a mill-man was badly tripped, thinking that as long as we did not know the weights, he could polish up his figures to make them look well. A few moments with a pocket slide-rule will do wonders in getting a clear notion as to mill-men's honesty, and when confronted with the actual figures it frequently jolts them to such an extent that they confess. On the other hand, we have frequently met operators who were quite at home with the theoretical method of checking results.

That such theoretical calculations bear out actual practice wonderfully well, is shown by the instances mentioned by Mr. Hoover, and is also corroborated by our experience. In one particular case some four years ago, in the operation of a plant treating an ore carrying lead and silver, and in the treatment of which only two products were made, lead concentrate, and tailing, we wanted accurate and quick records. For a number of weeks full records were kept of all weights and assays, and at the same time the results were calculated on the basis of using only the weight of concentrate and the assay of ore, tailing, and concentrate. The results by the two methods were invariably so close as to warrant a discontinuance of the weighing of the ore and tailing, work which was expensive as it had to be done by hand. The concentrate only was then weighed, and the ore, tailing, and concentrate carefully sampled and assayed. Assays were made for lead and silver, and, of course, by applying the formula, the ratio of concentration, when calculating on either lead or silver, had to be the same. This gave us a direct check on the assayer, and much to his surprise we were able, by a few moments on the slide-rule, either to accept them promptly as correct or return them for check determinations. As we recollect it now there was not one instance in which they did not agree when returned to us corrected. We have always taken pleasure in instructing mill-men, whenever they were ignorant of this method of calculation, and we have found that in every instance this has facilitated their work. What is more important, it has given the results promptly, eliminating the loss of time required for laborious calculations.

DIETZ & KEEDY.

Boston, September 15.

Associated Mines.

The Editor:

Sir—In the 'Review of Mining' for August, you make several mis-statements which have personal application to myself and some members of the staff.

You state that the error in the ore reserves was due primarily to the fact that I am a metallurgist with scanty experience in directing the underground operations of a mine, and was in the hands of foremen and surveyors by whom I was misled. Permit me to point out that in over 20 years' experience since the completion of a mining school course, for 12 years I have been actively engaged in the control of underground work, including four years acting as underground manager and surveyor.

The foremen and surveyors mentioned by you are capable and honourable men, and, al-

though responsible for a large amount of detail work, have never been in a position to mislead anybody, particularly myself. Anyone familiar with the systems of the larger mines regarding samplings, assay-plans, etc., will appreciate that fact. The main difficulty of ore estimation lies in the interpretation of a large mass of continually accumulating data and this duty has always been my own and has never been delegated.

I do not propose to go into the peculiar difficulties of ore estimation in the case of the Associated mine or the other points raised in your article; Professor Liveing has recently completed an exhaustive examination of all matters and will report to the Company. Suffice it to say that during the five years of my management of this mine, several gentlemen, eminent in the mining profession, have from time to time looked into its affairs and in no case has an alteration in the mining methods been suggested.

I am certain that a journal of the standing of the Magazine will be pleased to correct any false impression it may have inadvertently caused.

G. M. ROBERTS.

Kalgoorlie, September 30.

Secondary Enrichment.

The Editor:

Sir—As a constant, though distant, reader of your valuable magazine, in which I see numerous mining questions debated by correspondents, perhaps I may be excused for raising yet another point which seems to me of importance. It is in connection with the technical training of engineers. Of course, I may be quite out of date by this time, as I have not been away from South Africa for nine years, but unless matters have changed very considerably during that period there must be much room for reform with regard to the character of the theoretical instruction imparted at Schools of Mines in the Old Country. That the changes have not been great seems evidenced by the ideas I find prevalent among my juniors whom I meet from time to time out here. It seems to me that European ideas regarding mining geology in general, and the origin of workable ore deposits in particular, are in urgent need of revision to become applicable to many of the problems that present themselves in actual practice. To take a definite instance: one of the first generalizations from experience which most of us are compelled to make, who have to inspect newly opened properties, is that the surface gold values of a 'reef' do not usually go down. (I trust purists will pardon the use of the term 'reef' as it is invariable in South Africa.) In 9 cases out of 10—I was nearly saying 99 out of 100—they fall to little more than traces at the water-level. I think I am fully justified in using the expression "generalization from experience," as, to the best of my recollection and belief, I have never even heard of secondary or surface enrichment processes until, some time after my arrival in Rhodesia, a well-known engineer kindly lent me some up-to-date American literature on the subject. I have read several recent English, French, and German works dealing with ore deposits, and find that they mostly pass over in complete silence this important matter, while dilating at length on several genetic theories, which can only be regarded as pure hypothesis, if not, indeed, altogether at variance with plain facts. Is it fair that the European student should have to go out into the world so severely handicapped? Of course, it may be said that students do not become responsible engineers without preliminary experience. But what does their experience amount to as a rule in South Africa? Usually a few years on a Rand mine, where everything tends to confirm the notion that values go down for ever. It need hardly be stated that this has repeatedly led to remarkably erroneous estimates of the value of prospects in the case of orebodies more normal than those of the Rand.

F. P. MENNELL.

Bulawayo, October 6.

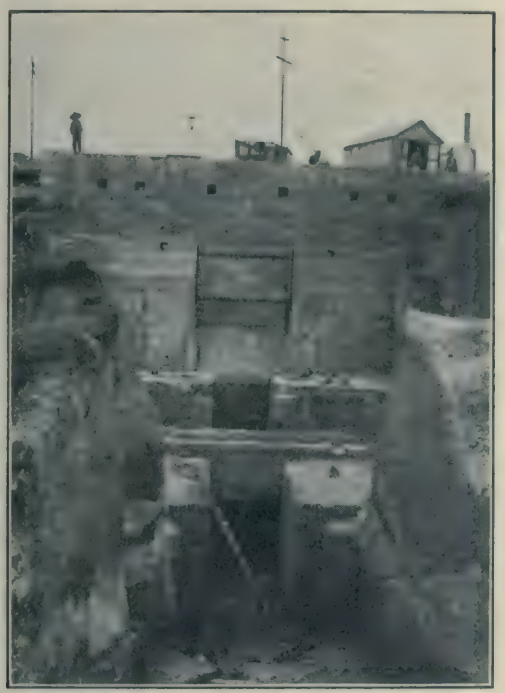
[We forgive our correspondent for using the term 'reef,' but we deeply regret his use of 'values.' An abstract quality, such as value, cannot "go down" save by the agency of an accountant's pen or an appraiser's pencil.—EDITOR.]

We note with pleasure that the *British Columbia Mining and Engineering Record* will continue the useful service formerly done by the B. C. Mining Record. The August and September issues contain much timely information on the diversified region from which this paper derives its name.

At the property of the Utah Copper Co. practically all the mining is done by steam shovels, of which 18 are at work and 2 more are on order. Even at the present curtailed rate the output is 13,000 tons per day. When all 20 shovels are at regular work the daily production will be 20,000 tons.

COMPANY REPORTS

Camp Bird.—This company was formed in 1900 by the Venture Corporation to acquire from T. F. Walsh the Camp Bird gold mine, Colorado. The purchase consideration was £699,163 in cash and £102,000 in fully paid shares, together with 25% of the profits until £400,000 had been paid in this way to the vendor. At the end of 1909 the Santa Gertrudis silver mine in Pachuca, Mexico, was acquired and a separate company formed, the Camp Bird company subscribing for 1,155,815 shares in it. The necessary cash was supplied partly out of balance in hand, and partly by the issue of 280,000 reserve shares at 27s. 6d. and £500,000 debenture stock. The report for the year ended April 30 shows that the stamp-mill treated 79,714 dry tons of ore and recovered gold to the value of $2,448,869,



Foundations for Santa Gertrudis Mill.

and that the cyanide plant treated 72,321 tons of tailing and recovered gold worth $196,751, bringing the total yield to $2,645,620 or $33·18 per ton. The total cost at the mine was $676,014 and after allowing for small items of revenue the net profit was $1,974,212. The revenue account in English money shows the income to be £544,024, and after deducting London expenses and allowances for depreciation, the balance of profit was £389,577. Out of this £88,609 was paid to the estate of T. F. Walsh as the proportion of profit due under the agreement of purchase, and this account is now closed, as the total payments have reached £400,000. The amount distributed as dividend was £178,000, and £270,607 was allocated to the purchase of Santa Gertrudis shares, most of the latter amount coming out of the balance brought forward from the previous year. William J. Cox, the general manager, reports that 8278 ft. of development work was done during the year, and that on April 30 the reserve consisted of 45,300 tons broken in the stopes and 38,600 tons blocked out, the total content being sufficient to yield a profit of £284,220. The developments during the year have added to the resources of the already established stopes, but the discoveries in new ground have been unimportant. Further exploration work is being continued under the advice of J. E. Spurr, who a year or two ago made a thorough geological examination of the ore deposit. The outlook does not present any very favourable features.

A report on the Santa Gertrudis by W. J. Cox is appended. Possession of the property was obtained on January 23 and the re-organization was complete in March. At first a lack of power hindered operations but by August suitable arrangements were concluded with the power companies. The first thing done by Mr. Cox and Hugh Rose, the manager, was to curtail stoping until the new treatment plant was ready, and in the meantime an active development campaign was undertaken. The driving on the 17th level was completed, and another level started. The work on the 17th level disclosed ore of greater value than estimated. Some of the upper levels abandoned by the previous owners were reopened and large amounts of ore have been found that was left behind as being of too low a grade, but which under modern methods of treatment will yield handsome profits. Steps are being taken to increase the haulage capacity and to substitute electric for steam power; air compressors are also being added. As regards treatment the former owners used to divide the ore into two classes, one being sold to the smelters and the other treated at the patio at the mine. Shortly before the transfer the erection of a cyanide plant was commenced 2½ miles away from the mine. This plant has a capacity of 250 tons per day and was put into commission not long after the present company obtained possession. It has been decided however to build a new mill at the mouth of the mine and so obviate the high cost of transport. The new mill will have a daily capacity of 600 tons. It will contain 60 stamps of 1550 lb. each and 10 tube-mills together with Pachuca agitator-vats and the most modern filters and precipitation plant. It is expected to be at work by March of next year. The accompanying illustration shows the foundations for the new stamps.

Spassky Copper.—This company was formed in 1904 to acquire the Spassky smelter, the Yuspenssky copper mine, and the Karagandy coal mines, in the Akimolinsk district, Siberia. Reports were made by E. T. McCarthy and by Pellew-Harvey & Fell, and E. Nelson Fell was the first manager. The last-named was succeeded by H. C. Woolmer two years ago. The share capital was increased from £300,000 to £350,000 in March 1909 by the issue of 50,000 new shares which were guaranteed by L. Ehrlich & Co. and the Consolidated Gold Fields of South Africa. There are in addition £212,650 debentures which have been issued at various times. The copper occurs in a deposit which is notable for the richness of the veins. It has been difficult to set operations going in the past owing chiefly to the distance of the copper mine, smelter, and coal mine from each other and from the Siberian railroad system. The report for the year ended September 30 has now been issued. It shows that during the year 1641 tons of copper was produced, realizing £127,340. The cost of production was reduced in August 1909 to £41 per ton, and since then the average has been only £29 per ton. At the Yuspenssky mine the main shaft has been sunk to 490 ft. and the developments at the 420 ft. and 490 ft. levels are highly satisfactory. No decision has yet been arrived at as

to the best method of treating the great quantities of low grade silicious ore in the mine. The amount of ore raised from the mine during the year was 15,551 tons averaging 15 to 18% copper, a rate which has been considerably increased since. During May of this year 2254 tons was raised. The amount of ore treated in the blast-furnaces was 10,794 tons containing 16·6% copper. The accounts for the year under review show a profit in Siberia of £28,839, out of which £15,230 is paid as interest on debentures and loans, and after London expenses have been paid the net profit for the year was £9522. Since the close of the year a first dividend of 2s. 6d. has been declared. During the year Mr. Woolmer has done some prospecting on some other parts of the company's extensive property and this feature of the company's work will be gradually extended, for it is recognized that the surrounding country is highly mineralized and should repay exploration. The directors have also decided that the time has come when the company might use its established reputation in Russia for the furtherance of other mining schemes within the Empire.

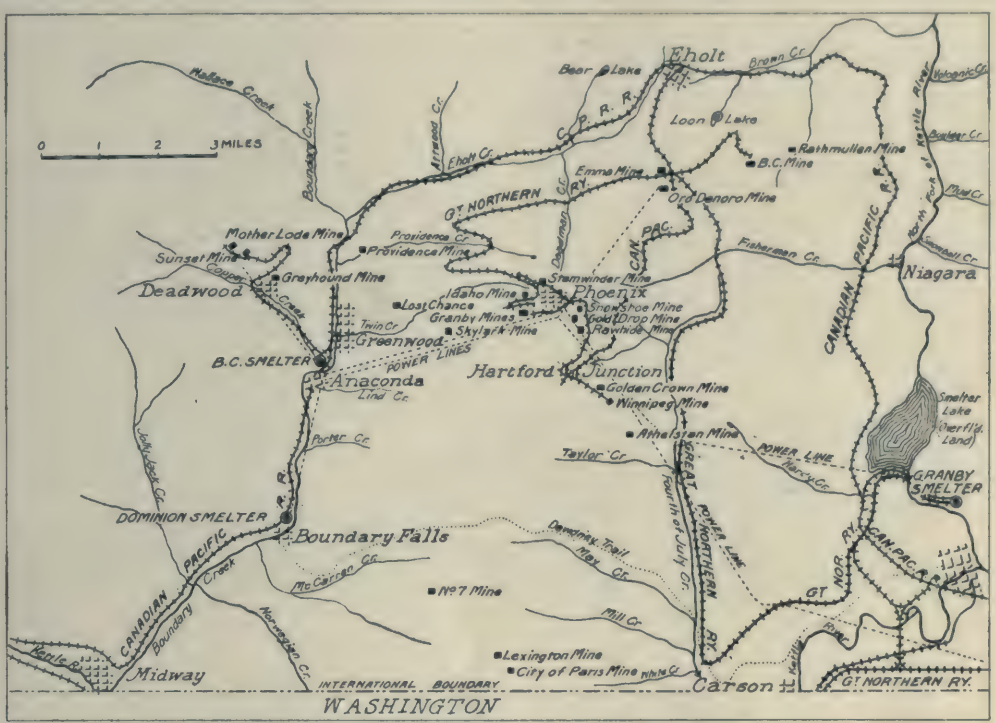
Caucasus Copper.—This company was formed in 1900 to acquire the Dzansul copper mine in the Russian Caucasus. Several high-class mercantile firms in London hold the shares, and a large interest is in the hands of the J. P. Morgan group. The ore is plentiful, of low grade, and difficult to concentrate. The first attempt at treatment was by direct smelting, but so large an amount of flux had to be added that the copper content of the furnace-charge was unprofitably low. Subsequently dry magnetic concentration was tried without success. Two years ago James Colquhoun, the former manager of the Arizona Copper company, joined the board and undertook the study of the concentration problem. The report for the year ended May 31 shows that the new plant devised by Mr. Colquhoun is giving satisfaction, and is now treating 500 tons of ore per day. The monthly production of concentrate is now sufficient to yield 200 tons of copper in the smelter. The directors have decided to immediately increase the capacity by another 250 tons and later to bring the total capacity to 1000 tons per day. During the year ended May 31, the production of copper was 1140 tons and the loss on operations was £27,590. In addition £48,840 was spent on new plant, and £99,320 was written off for useless plant. The roasting furnaces at present in use are not sufficient to treat the output, and two new furnaces are being erected. The supply of power is being increased by passing the gases from the reverberatories through water-tube boilers. The smelting department has been for seven years in the hands of W. R. Van Liew, and he has recently been appointed general manager to the company. The amount of money spent in this venture has been great as may be seen by an inspection of the balance-sheet. The capital is £500,000, and there are £636,000 debentures; in addition £459,900 has been advanced on loan. It will be seen that even with the increased plant, the profits can hardly be sufficient to yield an adequate return on the money invested.

Murex Magnetic.—The report of this company covers the period from its formation in April 1909 to the end of June last. The company owns the patents for the Murex process of wet magnetic concentration invented by A. A. Lockwood, and technical details were given by us in our issue of October last year. The directors' report and the chairman's speech at the meeting of shareholders reviews the progress made so far. A plant was erected at the Cordoba copper mine in Spain; this is doing well on all classes of ore and dump material, and an additional unit has been ordered. The plant erected at the Broken Hill Block 14 mine has not progressed so rapidly, partly owing to the illness of the engineer who was sent out and partly because the old plant offered for use was not easily adapted to the process. The latest cable is that the engineer now in charge sent 73 tons of zinc-lead ore as it came from the mine through the machine in 30 hours, and that the tailing contained only ½% zinc, 2% lead, and 1·9 oz. silver. It is announced that Mr. Lockwood is to go to Broken Hill shortly. Arrangements were made with Alexander Hill & Stewart to erect a plant at the Van Roi mine, British Columbia; this arrangement was subsequently modified by building the plant at a smelter in that country, so that mining engineers and metallurgists wishing to inspect the process shall have easier access to it. A plant is being sent to a silver mine in Bolivia belonging to Aramayo & Co., and another to the Malines zinc-lead mine in France. It is also announced that a contract has been made to treat an ore consisting of blende and magnetite found at the Cristoff mine, Germany. These last three plants as well as the Cordoba plant have been supplied on a royalty basis. The directors report that patents have been obtained in every country without any difficulty and that no opposition to them has so far been signified. The capital of the company is £120,000 of which £89,217 went as purchase of patent rights; about £25,000 has been spent on plant, experimental work, and administration; and about £7000 remains in hand. The directors expect to be drawing an income from royalties before long.

Consolidated Mines Selection.—This company was formed in 1897 to amalgamate two exploration and finance companies, one an English company, and the other identified with German interests. R. J. Frecheville and Walter McDermott are on the board and W. L. Honnold is consulting engineer. The chief interests are on the Rand where the company has the control of the Brakpan and Springs gold mines and the Transvaal coal mine, all situated in the far eastern part of the Rand. The company has interests through the West African Mines Selection Syndicate in the gold mining property of the Wallis Company, and controls the Viloro Syndicate which operates a dredge in the Oroville district, California. There are also a great number of other smaller holdings. In the report for the year ended June 30 the directors state that the company has had little opportunity for new business in South Africa. A profit of £64,530 was made by the sale of securities held and £31,341 was received as interest and dividends. The company started the year with a balance to credit in the profit and loss account of £72,621, and after paying debenture interest £14,905, and management expenses £20,801, the balance in hand at the end of the year was £137,148. At the same time a continuous fall has taken place in the securities held by the company and £277,040 has had to be written off for this reason. The balance sheet shows £1,105,000 in shares, £258,120 debentures, and £333,837 liability on purchases of stocks and for money lent for investment to the company. On the asset side, £1,211,265 represents shares in other companies, £207,596 advances against security, and £421,368 cash at bank and at short call. During the year the share capital had been increased by £105,000, and the shares thus created issued in exchange for debentures. The report gives recent information about the South African subsidiaries. At the Brakpan gold mine, 773,754 tons averaging 6·7 dwt. over 55 in. had been added during the year to the reserve, which on June 30 amounted to 1,222,603 tons. It is expected that everything will be ready for the commencement of stoping in April next.

At the Springs property one shaft is down 480 ft. and the other 517 ft.; on account of water difficulties the sinking has been slow. The Transvaal coal mine produced 223,584 tons during the half year January to June.

Granby Consolidated.—This company was formed in 1901 to consolidate a number of copper mines at Phœnix, British Columbia, and to acquire the Granby smelter at Grand Forks. The control is identified with the American Metal Company of New York and J. Langeloth is president. In our April issue we recorded that a sensation had been caused by the report of Otto Sussman who had been commissioned to make an independent examination. Briefly his view was that, though there were extensive reserves, the orebodies were rapidly contracting with depth. It had been generally supposed that the wide low-grade veins would continue in depth and Mr. Sussman's opinions and proofs to the contrary were quite unexpected. The report of the company for the year ended June 30 has just been published, and it contains reports by Mr. Sussman and by J. P. Graves the general manager, O. B. Smith the superintendent at the mines, and by W. A. Williams the smelter manager. The combined reports are of special interest as they embody a history of the company as well as news of the present condition. For some time the directors had intended to obtain an independent report on the mines, and on the resignation of A. B. W. Hodges, the mine superintendent, in January last, to accept the management of Cerro de Pasco, the occasion for the examination seemed opportune. Otto Sussman was therefore instructed to undertake the work. Owing to the low price in copper the smelter had been working at less than full capacity for three months before Mr. Sussman paid his visit. The history of the smelter is interesting. When the company obtained possession in 1901 there were two blast-furnaces in operation and two more were immediately added. In 1904 and 1905 four more were built and in 1909 the eight were rebuilt and made 48 by 266 inches, at the same time the height of the charge being increased from 9 to 13 ft. The converter plant was also remodelled. The capacity of the furnaces is now 4500 tons per day. The power is supplied by electric current purchased from various hydro-electric companies. The eight furnaces were fully employed until December 1909 and since then either five or six have been in commission. For the year ended June 30 the average has been 6½ furnaces. The amount of the company's ore smelted during the year was 1,175,548 tons, and 21,829 tons of custom ore was purchased for $191,828. The yield



THE BOUNDARY DISTRICT, BRITISH COLUMBIA.

from the furnaces was 10,156 tons copper, 355,749 oz. silver, and 48,804 oz. gold. The average price received for the copper was 12·9 cents per pound, for the silver 52½ cents per oz., and for the gold $20 per oz. The total receipts were $4,099,925 and the working expenses $3,343,149. Allowing for the cost of purchased ore, the net profit for the year was $564,946. Out of this $270,000 has been paid as dividend being at the rate of 2%, and $266,154 was allowed for depreciation. In January the directors issued 13,500 new shares at $85 per share to redeem extra expenditure on the mine and smelter during the last few years. After deducting the price received for the gold and silver from the total costs, the cost of producing the copper works out at 10·3 cents per pound. This apparently does not include the depreciation mentioned above. Mr. Sussman in his report estimates the ore reserve at 6¼ million tons averaging 1¼% copper, ½ oz. silver, and 0·8 dwt. gold per ton, figures practically identical with those of the manager. As already mentioned Mr. Sussman does not consider the chances great for any

discoveries below the present workings, and he foreshadows a reduction in the output and also the necessity for looking for other properties. The mining and smelting plant is in excellent order.

Bisichi Tin.—This company has been formed to acquire a tin gravel property in Bisichi valley, Northern Nigeria. H. W. Laws, general mining manager for the Niger Company, is the consulting mining engineer, and he has reported on the property. Trial pits have disclosed the presence of 2,120,000 cubic yards of gravel averaging 7½ lb. of tin oxide per cubic yard. This means a total content in the proved area of 6800 tons of tin oxide. The river bed is estimated to contain an additional 1000 tons. Mr. Laws estimates the total cost at £45 per ton, of which £15 is the actual cost of mining and sluicing. The ground tested is only one-tenth of the whole concession. The nominal capital of the company is £200,000, of which £143,000 in shares and £7000 in cash goes as purchase price, and the promoters have subscribed £50,000 as working capital. Among the directors is W. S. Coutts, a partner in Adamson, Gilfillan & Co., of Singapore and Penang.

Gel Tin Lode & Alluvial.—This company has been formed by the New African Company to acquire from the Niger company a tract of alluvial ground along a river in Northern Nigeria, adjoining the property of the Naraguta company. A statement equivalent to a prospectus has been publicly advertised. In this it is stated that during the first eight months of work, 305 tons of concentrate was produced by the former owners. H. W. Laws, chief mining engineer for the Niger company, has reported on the property. He states that the bed of the river is rich in tin, but the nature of the deposit precludes accurate sampling, though the value of the gravel may be judged by the fact that by means of calabashes, 50 workers have won 10 tons of concentrate per month at a cost of £10 per ton. For 8 months of the year this rate of extraction can be maintained, and during the 4 wet months the yield will be less. The company also acquires a half share in an option on a tin lode, upon which the Niger company has been working for some time. The published information about the alluvial and lode properties is of the scantiest and is not sufficient to enable an outsider to form an idea of the value of the propositions. The capital of the company is £100,000 divided into 400,000 shares of 5s. each. Nothing is said relating to the purchase price or the amount of money required or guaranteed for working capital. Nor is any indication given of the method of working the properties.

Deccan Gold Fields Development.—This company was formed in 1905 to acquire from the Hyderabad (Deccan) Company certain mining rights in the Raichor Doab District, Hyderabad, South India. During the past year operations have been centred on the Mangalur mine and investigations have been undertaken with a view of testing the value of the orebody. P. Bosworth Smith, the manager, has submitted a report on this property and the directors issue it with their report and balance sheet for 1909. From this it appears that 26,000 tons of ore containing from 7½ to 10 dwt. per ton has been proved. He recommends the erection of a stamp-mill large enough to produce 700 to 800 oz. per month. This will cost from £5000 to £7000. Before making a final decision the directors requisitioned the services of Thomas Richards, who recently retired from active work at Nundydroog, and after a full examination he endorsed Mr. Bosworth Smith's recommendations. The company has ample funds, as the 71,026 shares issued still have a liability of 7s. 6d. The shareholders agreed to the proposition and further instalments of capital are to be paid up in order to go forward with the equipment and development of the mine.

Pachuca Light & Power. — As recorded in our August issue, the Mexican Light & Power Company has recently purchased the plant of the Compania Electrica e Irrigadora de Hidalgo as the nucleus of a large business in the Pachuca district. A subsidiary company called the Pachuca Light & Power Co. has been formed under Mexican laws with a share capital of 4 million pesos (equal to £400,000) and 12,000,000 pesos in 5% gold bonds (equal to £1,200,000). The shares are entirely held by the Mexican Light & Power, and £800,000 of the bonds are now offered for sale. The proceeds will be applied as to £382,800 for the retirement of outstanding debentures, £127,000 for the payment of expenses already incurred in connection with extensions of plant, and the balance for financing further extensions. The remaining £400,000 of bonds are held for future issue when additional construction work becomes necessary. The plant acquired from the previous owners comprised a hydro-electric installation developing 6000 h.p., and an extension to provide an additional 6500 h.p. is now in hand. During the next five years it is expected that the output will gradually be raised to 25,000 h.p. The company contemplates the extension of the field of operations to Zimapan at an early date. As regards the profitableness of the business, the prospectus states that the net profit during 1910 is expected to be £58,943 and that the net profit for 1911 is figured at £85,750.

Jicaro Gold Estates.—The prospectus of this company was advertised during October. The object is to acquire and develop the San Cristobal and other properties in the Jicaro gold mining district, Western Nicaragua. The district is on the Jicaro river and access is gained through the port of Corinto on the Pacific ocean and the town of Leon. The chief vendor is John May, of Leon, and the San Cristobal property has been in charge of E. W. J. Edwards on his behalf. The report on which the property is acquired by the present company has been prepared by Mr. Edwards. The prospectus mentions that James A. Gilmour is consulting engineer to the new company, but no report is made by him. The capital of the company is £75,000, divided into 300,000 shares of 5s. each, of which 109,000 shares and £8500 cash is the purchase price, divided between Mr. May and the promoting companies. The promoters have underwritten 60,000 shares at a commission of 10%, payable half in cash and half in shares. The prospectus offers 140,000 shares for subscription by the public. As regards the properties, Mr. Edwards states that the developments at San Cristobal justify a mill and cyanide plant with a capacity of 25 tons per day, and that power can be obtained from a dam on the river Jicaro. He estimates the ore to contain £5 in gold per ton and that the cost should be 16s. per ton. If all the shares are subscribed £25,375 in cash will be available as working capital.

Rio Tinto.—The directors have issued their usual autumn report, and announce an interim dividend of 25% on the ordinary shares. A year ago the dividend was at the rate of 30% and the total dividend for 1909 was 60%. The information relating to the intended restriction of the output of metallic copper is of particular interest. It appears that the demand for sulphur ore is greatly increasing, so in view of the low price of copper, ore of lower copper-content is now being mined. Thus less copper will be marketed, the decrease for 1909 being estimated at 2000 tons. The directors note that this action on their part has had some influence on the American producers, and they

are able to forecast a general diminution in the production throughout the world. As regards the profit of the company, the directors indicate that it will be much less for 1910 than in 1909. The report also mentions that the work of removing the overburden is being hastened, and it is recorded that the recently increased reservoir capacity has enabled the mine and smelter to get through an unusually dry summer without any shortage of water.

Poderosa.—This company was formed in November 1908 to acquire a group of copper mines in the Collahuasi district, Chile, belonging to a local company called the Compania Minera Poderosa de Collahuasi. An account of this copper district was given in our October issue. The first manager was Robert Hawxhurst, but he did not remain long owing to disagreement between him and the board. Several of the directors retired at the same time and the board was reconstituted. C. H. Macnutt is now manager and W. J. Barnett is consulting engineer and also a director. The first annual report of the company covers the year 1909 and was issued early in June. It was not distributed at the time to the Press, and the meeting of shareholders was held privately. Hence the delay in quoting the report in these columns. The capital of the company is £500,000, in 100,000 shares of £5 each, and there are £50,000 debentures. During the year 1909, 25,782 tons of ore were sold to the smelters abroad and were delivered through the port of Mejillones. The average assay was 22% copper and 6½ oz. silver and the amount realized was £181,211. The cost of mining has been greater than was expected and amounted to £188,253, of which the cost of transport by rail amounted to no less than £40,489. In addition management in London and at the mine cost £16,945, mine development £7487, and £6069 was allowed for depreciation. The net loss for the year was £40,814, to which has to be added £26,458, an interim dividend paid in July by the former directors, making the total adverse balance for the year £67,272. This distribution of dividend was an error of judgment on the part of the board who had only a vague idea of what the cost of mining would be. The report now issued is a composite one. The work during the first half of 1909 is described by Mr. Hawxhurst and during the second half by Mr. Macnutt, while Mr. Barnett gives a general account of the mining operations. The shipments during the first half of the year were 12,909 tons averaging 24½% copper and 7·8 oz. silver, and during the second half 20% copper and 5½ oz. silver. In addition to this shipping ore, about an equal amount of ore was sorted out and placed on the dumps awaiting further treatment; the average content of this was 6% copper. The largest proportion of ore came from the Poderosa mine, about 20% came from the San Carlos, and a small amount from the Rosario. On December 31 the reserve at the Poderosa was estimated by Mr. Macnutt at 20,000 tons of developed ore averaging 21%, and 7000 tons of probable ore. The dumps at the three mines contain 64,800 tons averaging 5·6% copper. We may add here that the monthly reports now show an increasing output, the figures for September being 2392 tons assaying 22% copper. As regards smelting on the spot Mr. Barnett reports adversely. In the first place there is an excess of silica and no suitable flux is found near by; secondly the cost of carrying coke to the mine is high; and thirdly the ore reserves are not sufficiently great to warrant the capital expenditure. On other points he speaks hopefully of the prospects of the company.

Famatina Development Corporation.—This company was formed at the beginning of 1903 to acquire a copper mine in the Argentine Republic, situated 14,000 ft. above the sea in the Andes mountains. The progress has been slow owing to the successive managers either miscalculating the content and nature of the ore, or being incapacitated by the high altitude. The metallurgists who have reported on the method of treatment, among them T. C. Cloud, have been handicapped by want of knowledge of the resources of the mine. The directors have had much anxiety in connection with the financing of the company and from time to time issues have been made of various kinds of shares, participating bonds, and debentures. The balance sheet now issued covers the year 1909 and the accompanying director's report brings the information regarding the mine up to the beginning of October. The balance sheet shows issued share capital £555,470, 6% mortgage debentures £36,067, balance of income bonds £1800, and other liabilities £272,118, of which the greater part is included in 'Securities Suspense Account.' The expenditure for the year 1909 was £121,639 and the receipts from the sale of matte and copper was £50,476, leaving a debit balance for the year of £51,163. H. O. Powers was manager during 1909 and he re-started the smelter in March 1909. Results showed that pyrite smelting did not answer, so heap-roasting was adopted on trial. As the results in the blast-furnace with the roasted ore were satisfactory it was decided to order a roaster. In addition another converter was ordered. Hooper & Speak were

THE PODEROSA MINE, IN CHILI.

appointed consulting engineers in July 1909 and S. J. Speak went to the mine in December. Subsequently Hooper, Speak & Feilding were made general managers, and they appointed A. W. Jenks manager of the smelter, and J. C. Vivian was made superintendent of the mine. The report on ore reserves by Mr. Powers was not accepted by the consulting engineers, because it was found that much rock and low grade ore had to be mined in addition to the best quality ore, and they estimated the reserve at the Upulungos workings at 119,300 tons averaging 2·79% copper, 10¼ dwt. gold, and 9·3 oz. silver, and at the San Pedro 60,800 tons averaging 7·3% copper, 4 dwt. gold, and 1½ oz. silver. With the recently approved method of smelting and the correctly estimated resources of ore, the company will in all probability be able to report profits in the near future.

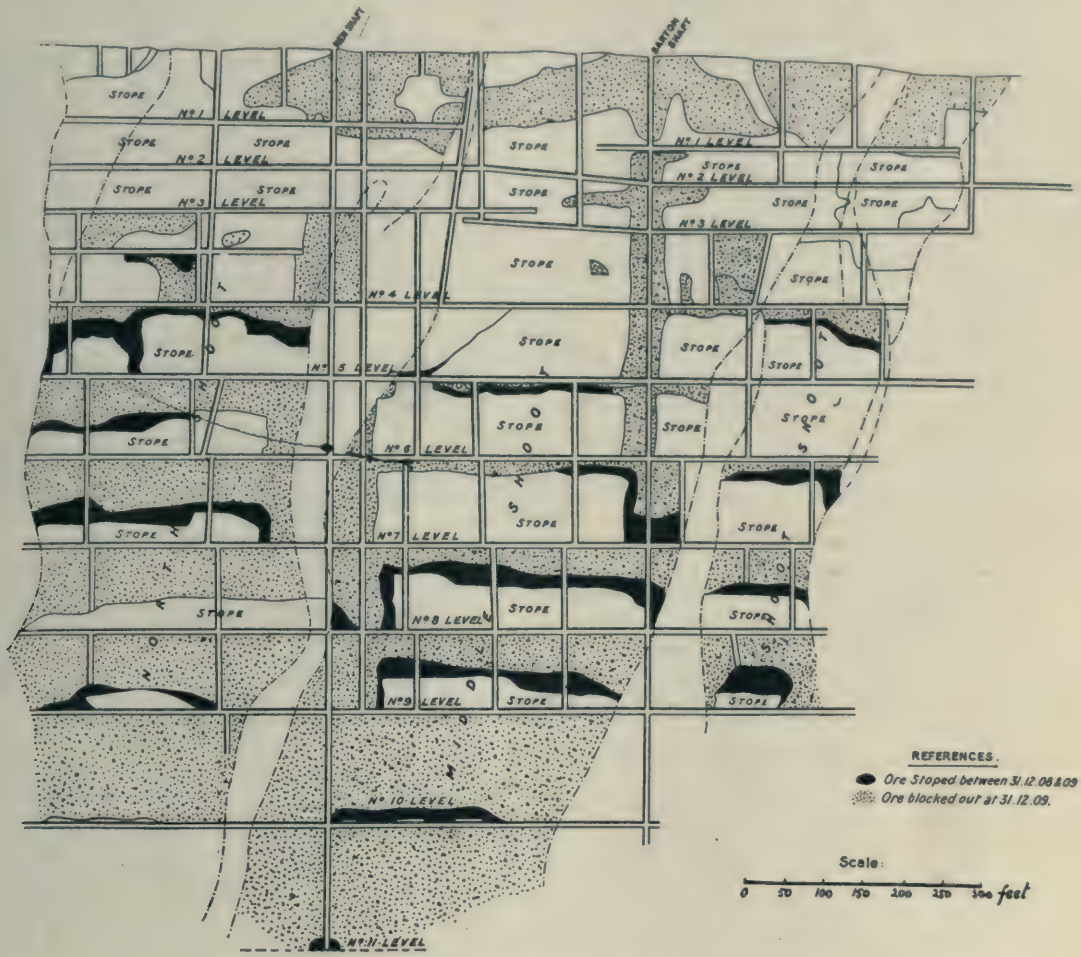
Whim Well Copper Mines.—This company was formed in 1906 to acquire a copper property in the West Pilbarra district in the northern part of West Australia, near the coast to the east of Roeburne. H. R. Sleeman is general manager. The report for 1909 shows that 6826 tons of ore was shipped during the year averaging 15·3% copper, with a gross value of £65,273. The net profit after all expenses of mining and administration were paid was £15,804. Out of this £20,729 was distributed as dividend being at the rate of 15%. Since the end of the year the capital has been increased from £150,000 to £200,000 in order to provide funds for further development and for the erection of plant. The ore deposit is found in a flat lode which has been proved for 3000 ft. along the outcrop, and for 2000 ft. it carries profitable ore. In the upper parts the ore is oxidized and below both by driving and by diamond drilling the deposit has been proved to contain sulphides high in sulphur and iron which will make a suitable smelting mixture with the oxide and carbonate. At the present time the best ore is picked and shipped to Europe in sailing boats. Before deciding on the method of metallurgical treatment on the spot, full investigations are being made as to the characteristics of the various kinds and qualities of the ore, and further developments will be made to prove the extent of the orebody. The directors also mention another property belonging to the company a few miles distant called the Mons Cupri. It is their intention to form a separate company to develop and finance this property. Taking it all round the Whim Well company appears to have an encouraging future before it.

Central Chili Copper.—This company was formed in 1894 to acquire the Panulcillo copper mine in Coquimbo, Chile, from the Panulcillo Copper Co. which was originally formed in 1864. The issued capital is £312,468, and small dividends were distributed in 1896, 1900, 1901 and 1907. A large proportion of shares are held in France. E. A. J. Goldschmid is chairman and B. C. Hinman is managing director. H. K. Masters has for some time been manager at the mines and he is now succeeded by H. M. McLaughlin. The report for 1909 now issued shows that 23,424 metric tons of ore was raised from the mines averaging 3·6% copper, and 20,252 tons bought from neighbouring mines averaging 7·72% copper. The smelter treated 26,260 tons of the company's ore and 19,199 tons of custom ore, producing matte containing 2144 tons of copper and £8485 in gold and silver. The low price of copper caused many of the adjoining mines to suspend operations, thus limiting the supply of custom ore, and making it necessary to utilize more of the lower grade ore produced at the company's mines. The profit and loss account shows a net profit of £6613 and as the year began with an adverse balance of £12,615 the company's operations still show a debit balance. During the year B. C. Hinman has visited the property and recommends the erection of a converter plant.

New Modderfontein.—This mine is situated in the far east Rand beyond the property of the East Rand Proprietary and is managed by the Rand Mines group. W. W. Mein has recently resigned the position of consulting engineer and is succeeded by H. Stuart Martin. The report for the year ended June 30 shows that the output of ore was 171,000 tons more than in the previous year, owing to the increase in the plant to 180 stamps and 5 tube-mills. The amount mined was 578,838 tons and after 9½% being removed as waste, 523,550 tons was sent to the mill. The yield in the battery was 121,890 oz. or 4·65 dwt. per ton, and in the cyanide plant 43,647 oz. or 1·68 dwt. per ton, a total extraction of 6·32 dwt., equivalent to 95¼% of the estimated content. This is a decrease in the yield of 1·4 dwt. as compared with the figures for the previous year. The income from the sale of gold was £695,410 or 26s. 6d. per ton, and the total cost was £415,545 or 15s. 10d. per ton, the income per ton being less by 6s. 9d. and the cost less by 3s. 11d. as compared with the previous year. The net profit was £279,865, out of which £165,000 was distributed as dividend, £26,603 paid as taxes, and £83,290 devoted to capital expenditure. In April last 50,000 new shares of £4 were issued at £11 each, and £550,000 additional capital was thus obtained for the purpose of immediately increasing the capacity of the metallurgical plant to 52,500 ton per month and for eventually increasing it by a further 39,000 tons per month. The latter extension will be effected by sinking a new shaft near the centre of the property and erecting a new mill adjacent to it. Mr. Stuart Martin is of opinion that a further £170,000 will be required for this purpose over and above the estimate made by Mr. Mein. During the past year the developments have greatly increased the reserve, which stood at 2,581,744 tons averaging 7·1 dwt. over 57 in., as compared with 1,564,434 tons averaging 6 dwt. The increase in the content is accounted for by the discovery of extremely rich ore on the 7th level. By the time the new shaft and plant are completed it is expected that between 8 and 9 million tons of ore will have been developed. The slime plant is to be extended on the lines of the experimental plant at Crown Mines where under the direction of F. L. Bosqui, the Butters filter has proved successful.

Great Cobar.—This company was formed in 1906 to acquire the Cobar copper mine, the most important copper producer in Australia. The purchase price was £800,000 in cash and £206,000 in shares and debentures. J. D. Kendall, C. M. Rolker, and W. J. Barnett reported on the property, and the first named became consulting engineer. The Lithgow refining works and the Chesney copper mine were also purchased. The company proceeded to erect modern blast furnaces and large sums were spent for the purpose. Unfortunately, the design was not adapted to requirements and in a great number of ways the working of the plant broke down. G. H. Blakemore, the manager, resigned, and subsequently J. D. Kendall followed suit. H. C. Bellinger, of Montana, was appointed manager at the beginning of 1909, and being a skilled copper metallurgist he has been able to gradually rectify the faulty construction. The report of the company for 1909 has just been issued, its appearance having been delayed by the disarrangement of operations caused by the Australian coal strike which stopped all work at the beginning of November last. The directors, however, have issued concurrently an interim report bringing information

up-to-date and at the meeting of shareholders held on October 12 the present position was still further elucidated. The mistakes in the design of the plant, together with the coal strike have cost the company large sums of money, which have been provided out of revenue. Owing to the imminence of the time when £100,000 a year has to be provided for the redemption of debentures, the directors have considered it advisable to recommend the creation of 30,000 new shares of £5 each and to hold them in reserve in case it should be desirable to issue some of them in exchange for debentures. It should be recorded here also that four months ago the property of the Cobar Gold Mines was absorbed. This was an important move for it gives the company a liberal supply of silicious flux containing 10 dwt. gold per ton in place of the barren flux which has hitherto been purchased and hauled from a considerable distance.



THE GREAT COBAR MINE.

During the ten active months of 1909, 163,449 tons of Cobar ore and 40,928 tons of Chesney ore, together with 42,718 tons of return material were smelted, and the amount of metal shipped was 5072 tons copper, 14,452 oz. gold, and 82,207 oz. silver. The most recent news is that the smelter and mine are now in a position to produce and treat 40,000 tons of ore per month and to produce 850 to 1000 tons of copper. The ore reserve on August 31 of this year was 2,877,000 tons in the Cobar and Chesney mines averaging rather under 3% copper, and 250,000 tons of gold ore in the Cobar Gold mine, the former figures showing a large increase over those on December 31. The main shaft at the Cobar is 1170 ft. deep and a level is being opened at 1150 ft. where the ore is as good as anything above. It is intended to sink further and start levels at 1300 ft. and 1450 ft. Diamond drilling shows that the lode in several of the levels can be worked profitably to a greater width than was at first supposed. The accounts at December 31 showed a profit of £53,938 out of which £41,640 went as debenture interest, and £11,700 was devoted to filling some of the stopes with waste.

Briseis Tin & General Mining.—This company was formed in 1899 to acquire the Briseis tin-gravel mine in the Ringarooma district in the northeast of Tasmania, and subsequently an interest in the adjoining New Brothers Home No. 1 Co. was acquired. In 1909, as the tin gravel is approaching exhaustion, the scope of operations was broadened and the words 'General Mining' were added to the name, at the same time options on gold-gravel properties in Victoria being obtained. The capital of the company is £600,000, and

the total dividends to date amount to 46¼%. The report now issued covers the year 1909. It includes reports by the consulting engineers, Lake & Currie, and by Lindesay C. Clark, the general manager. Concurrently an additional report by David Currie is issued giving the results of his investigation made two months ago. The report for 1909 shows that during the year 888,050 cu. yd. of tin gravel and overburden, in about equal quantities, were removed, as compared with 1,115,300 cu. yd. in 1908, the decrease being due to the cemented nature of the gravel and the increased hardness of the basalt overburden. The South section at Briseis is practically exhausted and the No. 1 will follow suit shortly. The output of black tin was 1102 tons as compared with 1395 tons, the metallic contents of which were 808 tons and 1020 tons respectively. Of the metallic tin 767 tons came from the Briseis property in 1909 and 914 tons in 1908, the remainder coming from the No. 1. The Briseis company takes 58% of the produce of the No. 1 Company's mine and 42% is paid to the owners. The total income of the Briseis company for 1909 from the tin property was £105,953 and the expenditure at the mine £37,668. The directors report that the Wallace gold-gravel properties in Victoria were acquired during the year and that a third dredge has been built. Much preliminary work is being done and £22,409 has been spent against a recovery of £4437 in gold. After payment of London office expenses, taxes, etc., and allowing for depreciation, the balance of profit is £33,852, of which £20,000 has been carried to reserve and £15,000 distributed as dividend being at the rate of 2½%. Since the end of the year the output of tin concentrate has been maintained at practically the same rate, and at the Wallace mine 252,890 cu. yd. yielded gold £3935.

Mr. Currie's report states that the Southern section of Briseis was exhausted in June of this year and that in the Northern section which as mentioned above consists of cemented gravel there was on September 1 a reserve estimated to contain at least 500 tons of black tin. No. 1 property was worked out in June. With regard to other resources, the borings at Krushka's Flat indicate the presence of over a million cubic yards of ground, some of which is old tailing, averaging 2½lb. of black tin per cu. yd. The Ringarooma property presents many difficulties and work has not advanced far. It is proposed to strip one face so as to ascertain the general nature of the deposit, and its ultimate exploitation will have to be further considered. Mr. Currie estimates that during the next three years an output of 45 to 50 tons of black tin per month can be maintained from the Northern Briseis and Krushka's Flat.

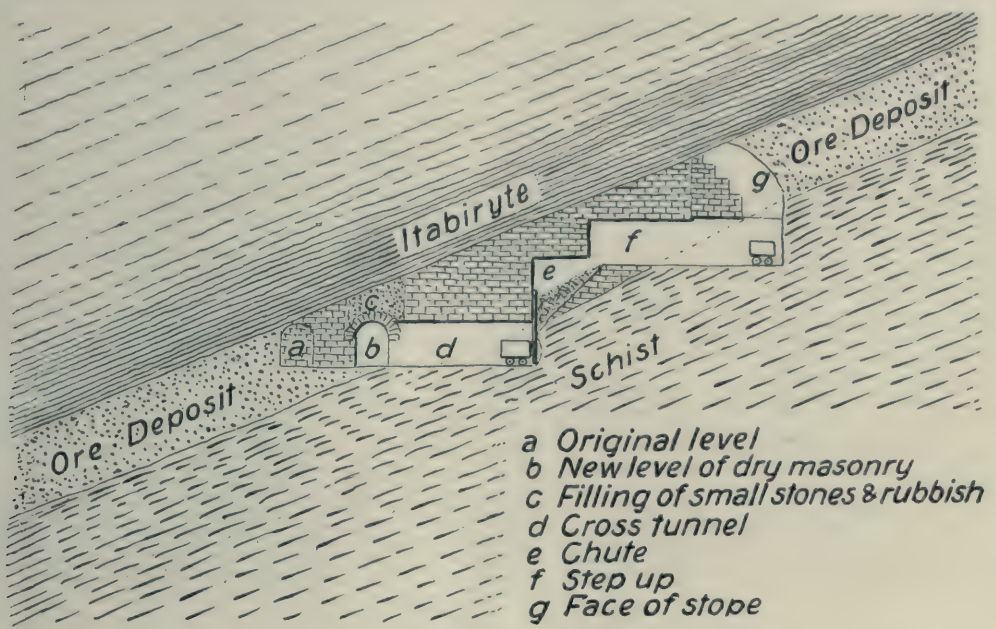
Simmer & Jack.—This is the leading mine of the Consolidated Gold Fields group. The report for the year ended June 30 shows that the production was rather less than during the previous year. At the time the mine was acknowledged to be enjoying a period of prosperity due to a combination of circumstances that could not be expected to continue. The decline is only small but the causes are of interest. In the first place the average number of stamps running during the year has been 300, or 20 less than the full capacity, owing to the fact that the mill has been gradually overhauled and new concrete foundations provided. Secondly there has been a scarcity of native labour and more machine drilling has had to be done, with the consequence that the stopes have been wider in many cases than they would otherwise have been and more poor quality rock has been mined. The report shows that during the year 920,303 tons was raised and after the removal of 10% as waste, 827,530 tons was sent to the mill. The yield in the battery was 105,105 oz. The 6 tube-mills treated 532,069 tons requiring re-grinding and their plates recovered 65,702 oz. The sand plant produced 64,702 oz. from 549,216 tons and the slime plant 21,050 oz. from 272,184 tons. The total yield was valued at £1,079,149 or 26s. 3d. per ton; the working expenses were £524,929 or 12s. 9d. per ton; and the profit was £555,529 or 13s. 6d. per ton. The cost was 3d. per ton less than a year ago and the yield 3s. 5d. less. The extraction was 94% of the content. C. D. Leslie, the superintending engineer, estimated the reserve on June 30 at 2,690,000 tons averaging 6·3 dwt., and in addition the partly developed ore is estimated at 440,000 tons averaging 5·5 dwt. Out of the profit £525,000 has been distributed as dividend being at the rate of 17½% on the capital. The report records the fact that this mine has been the first on the Rand to use current sand for filling stopes. The sand is sent to the stopes direct from the vats thus avoiding an intermediate carriage to the dump. The cyanide remaining in the sand is rendered innocuous by the addition of permanganate of potash. Many changes have been made in the metallurgical plant during the year chiefly in the substitution of classifying cones for the old spitzkasten and de-waterers.

Bunker Hill & Sullivan.—The report of this silver-lead mine at Wardner, Idaho, for the year ended May 31 shows that the first unit of the new or West mill came into operation last November. It will be remembered that a full account of the mill was given by Gelasio Caetani in our issues for May, June, and July. The capacity of this unit is 550 tons per day and a second unit of similar capacity is now being built. The old or South mill has run continuously, and as it is 20 years old much repair work has recently had to be done. The re-treatment of old tailing dumps which contain 2 million tons of material was commenced late in April at the North mill and by July the plant was in full working order, treating 22,000 tons per month at 12 cents per ton. During the year under review 377,530 tons of ore was mined; of this 1330 tons was shipped direct to the smelter and 376 200 tons concentrated. The amount of concentrate shipped was 63,686 tons. The gross value of the contents of the shipping ore and concentrate was $51 per ton; freight, treatment charges, and discounts totalled $20·23, and the mining and concentrating cost was $12·16, so that the working profit was $18·51 per ton. The total profit was $1,247,784 out of which $188,254 was spent in litigation, $147,150 on improved plant, etc.. and $42,595 on exploration. The net profit was $795,975 and the dividend declared absorbed $668,100, bringing up the total distribution since the commencement in 1886 to $11,639,100. The report by Stanly A. Easton, the manager, shows that the advantage gained by the new mill is already obvious, the cost of treatment having been reduced by 20 cents per ton of ore mined. The mines are developing in a most satisfactory manner and the reserve on May 31 was estimated at 3,184,572 tons. No deeper sinking has been done during the year and the vertical depth is only 600 ft. As the ore-body at Bunker Hill at the bottom level is of as great value as anything in the mine, the prospects as regards depth are excellent. The most important event of the year has been the settlement of the dispute with the Federal Mining & Smelting Co., and the agreement to amalgamate the two companies. Much litigation as to the ownership of veins will be avoided and mining operations will be simplified to the advantage of both companies. The re-arrangement has not yet been effected, as the Federal company has still some ore to extract as agreed in the contract for amalgamation.

PRÉCIS OF TECHNOLOGY

Zinc Smelting in the United States.—The interdependence of metallurgical operations and fuel supply is well illustrated by the present position of the zinc-smelting industry of the central portion of the United States. The Kansas and Missouri zinc deposits are large and many zinc smelting works have been erected. As natural gas was the most convenient and cheapest fuel, most of the Kansas works depended on this source of supply. An article in the *Engineering and Mining Journal* for October 15 describes the present position of the industry consequent on the exhaustion of the gas. The position at Iola, where the best gas supply of Kansas was found, is now becoming critical, after 12 years of enjoyment of an excellent fuel supply. During the coming winter it is expected that smelting will be suspended and operations continued elsewhere. The plant of the United Zinc & Chemical Co. has already been abandoned and the Lanyon Zinc Co. has only 4 of its 15 furnaces in operation. Probably the end will come in the early spring. The other smelters are struggling along at reduced capacity and their suspension cannot be long delayed. The conditions at other Kansas centres are much the same, especially at Cherryville, Altoona, and Neodesha. Only at Caney is the supply maintained. The lives of a few of the smelters has been prolonged by means of extensions of pipe-lines, and at Cherryville some of the furnaces are now fired with oil. The present position is a close repetition of the events of earlier years in Indiana. There several small zinc smelters were erected about the year 1892 but most of them had to suspend before 1900, owing not so much to the stoppage of supply but to its increasing cost due to demands for other purposes. Natural gas is still abundant in Oklahoma, and Bartlesville has become to the zinc industry what Iola used to be. The transfer of the industry to the Illinois coalfields is undoubtedly the logical outcome of the present situation. In this state the works at Lassalle and Peru have been in operation for some time, and have recently been supplemented by those at Depue, Springfield, and Danville. The amount of zinc sold by Illinois smelters in 1909 was 75,000 tons or 28% of the United States output, and the ratio will increase as time goes on.

Mining Methods at Passagem.—At the October meeting of the Institution of Mining and Metallurgy, A. J. Bensusan read a paper describing the Passagem gold mine, belonging to the Ouro Preto Gold Mines of Brazil, Limited. This gold deposit is situated in the State of Minas Geraes, Brazil, five miles east of the city of Ouro Preto. It was first worked 100 years ago and in 1884 it was acquired by the present company, John Taylor & Sons being the managers and consulting engineers. The country is mountainous and the valleys are steep. The altitude of the village of Passagem is 2300 ft. above the sea, and the highest hill overlooking the valley is 3000 ft. higher. The lode is a quartz intrusion along the plane of bedding of schists and it dips at an angle of 20° with the horizontal. The hanging wall consists of a micaceous schist containing much specular iron and may be classed as an itabiryte. The footwall is a talcose and micaceous schist carrying much quartz and the dividing line between it and the lode is not easily defined. Between the hanging wall and the lode is a thin layer of hard crypto-crystalline rock of similar composition to the hanging wall, and apparently the result of contact-metamorphism. The lode varies in thickness from a few inches to several yards; the part now being worked averages 9 ft. The bedding of the rocks and lode is much folded in many places, but there are no faults of any importance. Besides free gold the lode contains arsenical pyrite, and the metallurgical process has been specially designed. Other minerals found in the lode are tourmaline, garnet, and graphite. Its formation is generally considered by geologists to date from the Archæan age.



MINING METHODS AT PASSAGEM.

The method of mining adopted at Passagem presents some interesting features. Timber is scarce and costly, and as the hanging wall is treacherous, dry masonry arches and walls are built using the barren portions of the lode or parts of the footwall, and the spaces between them are filled with loose pieces of barren lode or country rock. The accompanying illustrations give an idea of the method adopted. The deposit is being worked from three inclined shafts close together at surface and spreading in depth. No. 1 shaft is inclined at 20° and is 2015 ft. deep on the dip; it is not now being used. No. 2 shaft is inclined at 18° and is 2512 ft. deep. No. 3 is at an angle of 13° and 3380 ft. deep. A secondary hoisting shaft has been sunk 754 ft. below the 2370 ft. level and follows the pitch of the ore-shoots. This will in future be used instead of No. 2 shaft, the sinking of which is being discontinued. The shafts are all sunk in the rock of the footwall, and the lode is reached by cross-cuts, from which levels are driven to follow the sinuosities of the hanging wall. The levels and cross-cuts are approximately 5 ft. 3 in. wide and 6½ ft. high. Chutes are cut by rising or sinking to connect the cross-cuts and the shafts in order to facilitate the delivery of the ore into the cars in the shafts. Stoping is commenced by attacking the ore on the upper side of each level and is continued for a few yards, until it becomes obvious that the roof must be supported. Work is then stopped and a dry masonry arch is built parallel to the main level and also walls for supporting the roof. The whole of the space between the arch and the hanging wall is packed with waste. Cross tunnels (*d*) are then opened so that stoping may be continued and the cross arches are built and the space above packed as the stoping progresses. The practice is to continue driving into the footwall sufficiently far to see if other outlying shoots of ore are present. The cross tunnels are then 'stepped up' as in the illustration, and a continuation of the tunnel made at (*f*). Sufficient space is left to provide a chute (*e*) for the ore. Between one level and another there may be two or more of these 'steps up,' the number depending on the inclination of the deposit and the pitch and direction of the ore shoot. After the second 'step up' it is usual to drive a rise to the level above and to bring the filling to the exhausted stope through the winze thus made. Readers of this paper may be referred to the dry-walling practice adopted at the Baltic mine, Michigan, an account of which is given in T. A. Rickard's book on 'The Copper Mines of Lake Superior.' The author in his paper gave details of the equipment of the mine, the method of arranging contracts, and other information of interest.

Metallurgical Practice at Passagem.—The second part of A. J. Bensusan's paper deals with the metallurgical plant at the Passagem gold mine, Brazil, belonging to the Ouro Preto company. At the same meeting of the Institution of Mining and Metallurgy another paper was presented by R. H. Kendall, the metallurgist to the company, covering exactly the same ground. The present abstract is taken from the two papers conjointly. The output of ore is about 6000 tons per month and the average assay is 7 dwt. per ton. Approximately one-half of the gold is free and the other half is associated with arsenical pyrite. Bismuth is also found in the ore and some of it is recovered. Owing to bismuth and arsenic the ore is not amenable to amalgamation and, instead, the pulp from the stamp-mills is passed over blanket strakes for the recovery of the free gold and some pyrite; subsequently it is sent to Frue vanners on which a pyritic concentrate is obtained, and then the tailing from the vanners is divided into sand and slime and treated by cyanide. About 5% of the gold in the ore is sufficiently coarse to accumulate in the mortar-boxes of the stamp-battery. This is the outline of the method of treatment and the two papers enter into details of the practice.

The plant is built at the mouth of the mine upon the steep side of the valley. There are 80 stamps of 750 lb. each, divided into two separate sets of 40, in houses one above the other. The ore passing the grizzleys goes to the upper mill and the coarser goes to rock-breakers and then down to the lower mill. As water is plentiful the whole of the motive power is obtained by turbines and Pelton wheels. The ore is crushed to pass 30-mesh and some lime is added; then the pulp is passed over blanket strakes measuring 4 by 1½ ft. and set at an inclination of 1 in 8. The blankets are changed two or three times every hour and they are washed in a cement tank which has a submerged grating. The amount of concentrate caught on these blankets every month averages 150 tons having an assay value of 8 to 9 oz. per ton. This concentrate is subsequently removed and re-concentrated on another set of blankets. Here a rich concentrate amounting to about 6 tons per month, and assaying 230 oz. per ton on an average, is obtained and the remainder of the 150 tons averages 16 dwt. per ton. The rich concentrate is further treated on another set of blankets and a concentrate averaging over 2000 oz. per ton is obtained. This is washed in bateas, and from 50 to 60 lb. of rich product containing 80% gold is obtained, and sent to the refinery. The tailings from the first and second re-concentrations are sent to the cyanide plant along with the pyritic concentrate obtained on the Frue vanners, and the tailing from the bateas is returned to the blankets used in the second re-concentration. The gold from the bateas is refined by digesting in nitric acid to remove the bismuth which is afterwards collected as sub-nitrate. About 2 cwt. of this is sold during the year.

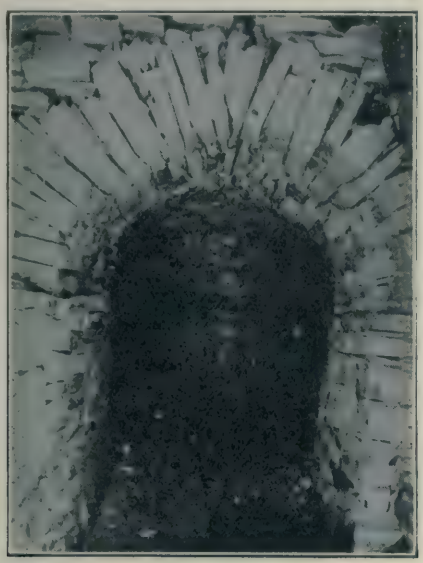
The pulp on leaving the blanket strakes in front of the stamps is treated on shaking blankets before going to the Frue vanners. By this means 6 or 7 tons of concentrate containing some free gold and assaying 16 oz. per ton is obtained. This is treated by cyanide along with the tailing from the second blanket re-concentration, the two products having practically the same gold content. The Frue vanners produce about 300 tons per month of concentrate averaging 22 to 25 dwt. per ton. This is treated by cyanide with the 150 tons of tailing from the first blanket re-concentration. The tailing from the vanners assays 1 to 1½ dwt. per ton, and it is separated into 75% sand and 25% slime by spitzkasten and these are treated by cyanide. There are therefore four different sets of cyanide operations, two of pyritic concentrate specified as 'special' and 'ordinary' and two of the vanner tailing. The 'special concentrate' is the mixture of the tailing of the second blanket re-concentration and of the concentrate caught in the blankets in front of the vanners. The 'ordinary concentrate' is a mixture of the tailing from the first blanket re-concentration and of the vanner concentrate, the monthly amounts being 150 and 300 tons respectively.

The 'ordinary concentrate' contains from 66 to 70% arsenical pyrite and 22 dwt. gold. It is first given a lime-wash in a vat built of stone and cement measuring 24 by 12 by 3 ft. and having a perforated bottom covered with matting. The lime is added in the form of clear lime-water which is supplied from a small tank adjacent, and the washing is done by simple percolation. When the effluent water shows decided alkalinity

the washing is stopped and a vacuum is created below the filter-bottom so as to remove as much water as possible. The charge is then shovelled out of the vat and thrown upon an airing floor where it remains for 24 hours. This drying and airing greatly increases the extraction. From the floor the charge is shovelled into four cement bins with wooden fronts, to be subsequently sluiced into four agitator-vats. The agitator-vats are each 7½ ft. diam. and 5 ft. deep, and are made of yellow pine. Cyanide solution containing 0·22% KCN is added in the proportion of 60 parts by weight of solution to 100 parts of solid and the mixture is agitated by revolving propellers for 22 hours. The charge is then passed to a filter 13 ft. diam. and 5 ft. deep, on the way 6 lb. of lime being added for the purpose of precipitating the hydrated oxide of iron held in suspension. The solution is removed by vacuum and sent to a zinc-box; a water-wash is then given and sent to another zinc-box. The consumption of cyanide is 2¾ lb. per ton and of zinc ¾ lb., and the extraction is 86%. The tailing from this process is subsequently passed over a series of blanket strakes and a concentrate assaying ¾ to 1 oz. is obtained. This is returned for treatment with the 'ordinary concentrate.' Further improvements are contemplated in this department of the work.

The 'special concentrate' amounts to 12 or 14 tons per month and the daily production is stored until this amount is accumulated. The average content is generally 16 oz. per ton, but varies occasionally. The treatment differs slightly from that of the 'ordinary concentrates.' The strength of the solution is 0·3%, and the proportion of liquid is higher, the amount being equal in weight to the solid. After 12 hours' agitation more cyanide is added, and after filtering the charge is sent back to the agitator for re-treatment. The residue after the first treatment contains 1 oz. per ton and after the second ½ oz. The material is stored for six months and run through the mill with the ore. This storing is effectual in facilitating recovery, and tests show that the final treatment after storing reduces the content to 3 dwt.

The sandy tailing from the vanners contains about 21 grains of gold per ton. The plant for treating it consists of 5 percolator-vats each 24 ft. diam. by 7 ft. 6 in. deep and holding 120 tons of sand. These are filled by a distributor which travels on a trolley suspended above. The filling of each vat occupies 16 to 17 hours. No lime is added as sufficient is used in the stamp-mills. By means of a vacuum the water is drained off, and the charge is given 4 hours' airing. The cyanide solution is then admitted. The first solution consists of 20 tons from the sump containing 0·08% cyanide and a trace of gold; this is followed by 30 tons of gold liquor from the slime-plant containing from 1½ to 2 dwt. of gold and 0·08% cyanide. All this time the solution is gradually withdrawn from the bottom by the vacuum and is passed through zinc-boxes, but when most of it has sunk into the sand the effluent from the bottom is returned to the vat by a centrifugal pump. This circulation is continued for 36 hours, and then the solution is withdrawn and wash-water applied. The extraction is approximately 15 grains or 2s. 7½d. per ton, and the total cost is 8d. per ton. The consumption of cyanide is 6 oz. and of zinc 1¼ oz. per ton.



DRY-WALLING AT PASSAGEM MINE.

The treatment of the slime from the vanners is rendered troublesome by the large amount of water used in the mill, this having been necessary to prevent gangue from settling on the blanket strakes. The slime contains only 2% of solid, but by using a large area of spitzkasten, and also because of the lime used in milling, comparatively little solid is lost. The authors describe in detail the cycle of operations of dewatering, dissolving the gold, removing the solution by vacuum, washing the cakes, and recovering the gold. This plant was only started in May 1909, and the figures for June were 900 tons treated, recovery 7s. 2½d. per ton, extraction 79%, and average cost 2s. 4d. per ton.

Electrolytic Lead-Refining at Trail.—In the September issue of *Mines and Minerals*, J. M. Turnbull gave a long account of the methods of smelting and refining at the lead and copper smelter belonging to the Consolidated Mining and Smelting Co. of Canada, at Trail, British Columbia. We gave an abstract of his account of the lead smelting practice in our last issue and we now give an account of the lead refining practice. The Betts fluosilicate process is used. There are 240 vats measuring 3 by 8 ft., and 3½ ft. deep, made

of pine and lined with asphalte. They are arranged in six double rows in a series of cascades and the electrolyte is kept in circulation by means of pumps. The dynamos generate 3500 amperes at 80 volts, and the vats are operated with a current density of 16 amperes per square foot of cathode area, the voltage averaging 0·32 per vat. Each vat contains 20 anodes which weigh 370 lb. each. The anodes are cast with shoulder lugs which rest on copper bars on the sides of the vats. They are spaced $4\frac{1}{8}$ in. apart. Each vat contains 21 cathodes made of lead sheets $\frac{1}{16}$ in. thick, which are hung upon copper bars measuring $\frac{1}{2}$ by $\frac{3}{4}$ in. by bending the top part of the sheets once round the bars. The cathodes are made slightly wider and deeper than the anodes in order to prevent short-circuiting.

The electrolyte is lead fluosilicate with an excess of fluosilic acid. It contains 12% of acid and from 5 to 6% lead. The acid is made by mixing fluorspar, silica, and sulphuric acid in a cast-iron pan, and the fumes are condensed in towers with water spray, which is used over and over again until its strength reaches 30% acid. This is freed from sulphuric acid by the addition of lead dross. It is found advisable to add from $\frac{1}{2}$ to 1 lb. of glue to the electrolyte for every ton of lead; this helps the deposit on the cathode to be coherent and so prevents short-circuiting.

The refining process takes about 8 days after which the remaining parts of the anodes amounting to 15% are sent back to the melting pot. Most of the gold and silver slime adheres to the anode scrap and it is removed by washing and scraping in a special tank. Some of the slime settles at the bottom of the vats and is removed about once a month. The cathodes are washed and melted and cast into pigs of a size to suit the market. For instance those sold to China weigh 190 lb. to suit the coolie transport. An average analysis of the pigs shows 99·99% lead, with minute amounts of zinc, silver, iron, copper, tin, and antimony, but no trace of arsenic or bismuth.

The slime is carried in copper cars to the treatment plant, where it is first washed with hot water to remove the electrolyte. The wash water is drawn off and evaporated by steam coils to recover the acid. After filtering, the slime is placed in cars and dried in the furnace flue, and when dry is melted in a water-jacketed reverberatory which is lined with magnesite brick. The impurities are here removed by oxidation, and the metallic fume is caught in cooling flues and returned to the blast-furnaces. The slime averages 35% silver, 0·035% gold, 25% antimony, 20% arsenic, 8% copper, with some iron, bismuth, and silica, and traces of tellurium and selenium. The doré metal is parted in sulphuric acid and the silver sulphate is run into steam-heated vats where the silver is precipitated as a slime by means of copper bars. The silver slime and the residual gold slime are melted and cast into bars, the silver being 999 fine and the gold 995 fine. The remaining solution contains copper sulphate which is recovered and sold as bluestone.

When commercial conditions warrant it, the antimony is recovered from the slime by a process devised by A. J. McNab, the superintendent of the lead plant. By this method the slime is boiled with sodium polysulphide, and the solution electrolysed between lead anodes and steel cathodes both in sheets. The deposit on the cathode is a dense hard antimony containing 2% arsenic which can be removed by melting with alkaline fluxes. The remaining slime is roasted in a muffle furnace and afterwards treated with 10% sulphuric acid which extracts 90% of the copper and 10 to 75% of the silver. This solution is heated in the presence of copper and the silver precipitated as before. The residual slime is then treated in the reverberatory as already described.

Ventilation at East Rand Proprietary. — At the August meeting of the Chemical, Metallurgical, and Mining Society of South Africa, Sydney Penlerick, one of the general managers of the East Rand Proprietary Mines, read a paper describing the ventilation system adopted when the company was formed to consolidate the operations of the Farrar mines, adjoining each other, namely, Driefontein, Angelo, Comet, and Cason, taken in order from west to east. Before going into details the author gives an outline of the considerations that influenced them in deciding to adopt an efficient system of ventilation. There are three causes of disease or discomfort in metal mines: (1) dust caused by drilling, blasting and shovelling; (2) the infective action of tuberculosis and similar complaints; and (3) the fumes arising from the use of explosives. As regards dust, the author describes how they adopted methods for checking the dust from the drill holes, provided water-sprays actuated from the compressed air mains for precipitating the dust of blasting, and hose-pipes for dampening the ore to be shovelled. These did not however cope with the finest dust which accumulates in out-of-the-way corners and is periodically raised again by blasts or other disturbance. The fact that this finer dust is not removed from the air in spite of all these methods of allaying dust was sufficient to induce the engineers to add it as an argument for ventilation by air-current. The provision of fresh air at the working faces, in order to protect the health of the miner and to recuperate his energies, and the extraction of fumes from the explosives were also powerful factors in deciding on the thorough ventilation of the mine. When the mines were consolidated in 1906, the Farrar (at the extreme western end) Comet, and Cason shafts were natural downcasts, and the No. 1 Driefontein and the Angelo were upcasts. It was decided to re-arrange the distribution of air, so all the above main shafts were made downcasts, and two old prospecting shafts on the Angelo and the Cason properties were brought back into use and made upcasts. Fan-houses were built at the surface. On the Angelo upcast a Sirocco double-inlet fan was provided measuring 10 ft. 6 in. diam. and 8 ft. 6 in. wide, delivering 300,000 cu. ft. per min. at 3 inches. On the Cason upcast was erected a Barclay's double-inlet drum type 16 ft. diam. 8 ft. wide, and delivering 350,000 cu. ft. per min. at 4 inches.

The system of distribution may be described by quoting Mr. Penlerick's account of the equipment of Farrar's shaft. This is a five-compartment shaft with a ventilating area of 145 sq. ft. The cross-cuts from the shaft to the various levels are bratticed, and in the upper levels, where no work is being done, the doors in the brattice are securely closed so as to prevent unnecessary circulation of air through the unused upper parts. From the 6th to the 17th levels self-closing doors are arranged in the brattice, and regulators provide the desired amount of air-current for each level. From the 18th to the 22nd or bottom level, the shaft is divided into a downcast and upcast by means of a brattice between the hoisting ways and the ladder way. The object of this division is to provide a return way for the air from the bottom of the shaft up to the level which is connected to the Angelo upcast, as there are no through connections between these bottom workings and the upcast shaft. On the west side of the Angelo upcast there is a transverse dike and advantage has been taken of it by making it a natural brattice. The levels running through the dike are permanently

closed where there is no haulage, and are closed with double swinging doors where tramming is done.

On the 21st level of the Angelo section an auxiliary ventilation plant has been provided. There are here three 9 in. and two 15 in. pipes delivering into a 21 in. pipe through which the air is exhausted by a 21 in. Sirocco fan fixed on the 19th level. The intake air is obtained from the main shaft. Before this fan was installed compressed air used to be delivered upwards through a vertical pipe thus causing an upward draught. As regards ventilating of development drifts it is found necessary to provide for an intake and outlet where a face is being carried much beyond the last connection with an adjacent level. This object is best attained by using a galvanized iron pipe for the outlet. An example of this is found in the Angelo Deep. This part of the property is not yet connected with the Angelo and depends on natural ventilation in the meantime.

The author proceeds to quote the beneficial effects of this system of ventilation on the air in the mine. Samples were taken, before the new fans were started, at the bottom of the Farrar, No. 1 Driefontein, and the downcast Angelo, at all of which sinking was going on. The average results of the analysis was 0·552% CO_2 and 0·011% CO. After the fans were started and the new system in working order the samples of air taken at the same points averaged 0·149% CO_2 and 0·006% CO. This shows a wonderful improvement, but subsequent analysis after the system had been at work for some time showed even better figures. For instance samples of air in the Angelo upcast taken after blasting when the vitiation of the atmosphere is greatest showed only 0·182% CO_2 and 0·001% CO. The average temperature of the air at the bottom of the mine is now from 2° to 3° lower than before the plant was installed. The capital expenditure on the ventilation system was about £25,000 and the operating cost including maintenance is less than 1d. per ton of ore milled. The cost has been insignificant compared with the valuable results obtained.

Clancy's Cyanide Process.—The *Engineering and Mining Journal* for October 8 gives considerable space to a discussion of the subject matter of the foreign patent applications describing the new cyanide process invented by J. C. Clancy. The invention consists of producing in the treatment vat an active cyanide from a cyanogen compound that is not a solvent of the precious metals but is much cheaper than the cyanide of potassium or sodium. This chemical change is brought about by an electric current passed between inert electrodes placed about 2 in. apart. The chemicals recommended by the inventor are cyanamide of lime, or a cyanate or thiocyanate of potash. The action of the current is to liberate oxygen, and it is therefore of direct value in preventing the formation of cyanate from cyanide, which is the chief cause of loss in ordinary practice. Proceeding further the inventor shows that the liberation of oxygen by the current can be used for aerating the contents of the vat without having recourse to mechanical aeration by compressed air. Another feature of the process is the addition of potassium iodide to the solvent solution, for the purpose of increasing the oxidizing effect. The iodide is electrolysed and the iodine acts as an oxidizer, and it is subsequently regenerated. In the article quoted a great variety of applications are given in detail, but it is only a discussion of the patent claims and no account of the process in practice is given.

Gravel Mining in Tasmania.—In the *Proceedings* of the Australasian Institute of Mining Engineers for April last a paper by Edward Edwards is published entitled 'Notes on Tin Sluicing in Tasmania.' The author describes in detail the gravel deposits in the valley of the Ringarooma river and its tributaries in the northeast of Tasmania, and the methods of hydraulic mining adopted. The Briseis is the most notable mine in the district. The Ringarooma river runs in a northeasterly direction discharging into the Boobyala harbour, and the tributaries run into it in a northwesterly direction. The original rocks in this district were slate and sandstones through which granite intruded. Most of the sedimentary rocks were removed by erosion leaving the granite exposed. The weathering of the granite produced extensive bodies of gravel deposits or 'drift.' Subsequently basaltic lava-flows covered this drift. Two distinct basalt flows can be traced, and between them at many places is a thin gravel deposit. These flows had the effect of shifting the river beds, as may be seen in the accompanying cross sections at two points in the Cascade deposit. The origin of the lava is not certain. The tin came from the granite as is proved by the constituents of the gravel being the same as those of the granite. The granite rock is in many places being worked for tin. The basalt has been much weathered and altered and the iron in it has been carried by descending water into the gravel below tending to cement it. The other parts of the gravel consist of white sand with fragments of granite, and here and there layers of white clay evidently derived from the felspar. The cassiterite is distributed throughout the gravel, and there are occasionally thin rich horizontal seams. As a rule the richest parts are near the bedrock. On the present river beds the gravel is worked by bucket-dredges, and on the old leads either by dredging or sluicing. The amount of overburden varies greatly and at some mines it is entirely absent. The present paper deals solely with the sluicing operations, and starts with a general discussion of the methods of estimating the value of gravel. The author then proceeds to describe the method of removing the overburden. At the Briseis the depth of the overburden was in some places 150 ft. and the centre of it was composed of hard columnar basalt. This had all to be removed by hydraulicking before the tin gravel below could be touched. As the height was so great the work had to be done in steps or benches; this method

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had the additional advantage that it made it possible to dump the material from the top benches upon the high ground adjoining the hill thus reserving the lower dumping areas for the material from the bottom bench and for the tailing from the tin gravel. Portions of the bottom bench were removed in the course of sluicing the gravel, the work on them being kept just sufficiently ahead for the accommodation of pipes, tail-races, etc., and to prevent any overburden mixing with the gravel in case a heavy fall of overburden should take place. Water for working the overburden is brought from the Ringarooma and Cascade rivers through 20 in. pipes and the apertures of the nozzles range from 3 to 7¾ in. The face is first undermined by directing the jet through one of the smaller orifices towards the bottom, and after some of the lower part is removed the whole face falls. If the basalt is hard it is necessary to bore holes at the top and blast by dynamite. The water is then allowed to accumulate within an enclosure or 'paddock' bounded between the face and the entrance to the sluice by means of wing-boards, and while the jet still plays the finer parts of the overburden are removed as thin mud, carrying with it considerable amounts of large pieces of rock. When everything possible has been washed down the sluice, men break the pieces remaining by means of picks and further quantities of small material are removed by sluicing. Eventually the larger remaining pieces are carted away, being first blasted if necessary. The tail-races are built of wood in 12 ft. sections and are lined with columnar basalt. The gradient is 1 in 37. As the Tasmanian laws limit the size of stones discharged into the river to 2 in. diam., it is necessary to have a grizzly at the entrance to the tail-race. The amount of overburden removed per year is over a quarter of million cubic yards, and the amount of water used averages 8000 gal. per cu. yd.

The tin gravel is also worked in benches, with the advantage that only that part of the deposit below the level of the gravitation tail-race has to be elevated. Most of the cassiterite remains behind in the 'paddock' or enclosure. Large stones left from the overburden are blasted and the debris from them and also the clayey portions of the gravel are carted away. A grizzly is arranged in the feed-race that carries the material down to the sluice in order to exclude large pieces. The sluices are 130 to 180 ft. long and 8 to 14 ft. wide, and are set at an angle of 1 in 30. Each sluice is built of 4 or 6 sections measuring 24 to 30 ft. long and at the end of each section riffles are provided, made of hardwood strips 3 by 2 or 1½ in. The structure is supported on trestlework. The feed-races are similarly constructed but are narrower, being only 3 or 4 ft. wide, gradually widening as they join the sluices. The depth of both is about 3 ft. At first only a few riffles are used, but as the cassiterite accumulates in the enclosure the level becomes higher and the stream is more rapid. Additional riffles are then put in so as to help to improve the recovery of cassiterite in the feed-races and sluices. The author enters into great detail as to the methods of keeping the work in good order and describes the process of recovering the accumulated cassiterite from the enclosure and from the sluices and races. The paper is eminently practical and is made additionally useful by working drawings.

The discussion on this paper was one of unusual interest. The small cost of the installation caused general surprise, and though it was admitted that all mines were not so favourably circumstanced as the East Rand Proprietary, yet the results indicated that thorough ventilation is not the expensive item it was thought to be.

The Use of Cobalt Compounds.—*Metallurgical and Chemical Engineering* for October discusses the prospects of an increased use of cobalt and its compounds, made possible by the recovery of cobalt from the ore found at Cobalt, Ontario. Hitherto the supply of cobalt oxide has been confined to the Saxon and Silesian works, where complex ores similar to those of Cobalt have been used for this purpose. The ores at Cobalt are so rich in silver that the cobalt, nickel, and arsenic contents are of minor importance, and practically no income accrues to the mines from this source. In many cases the ores are smelted in lead furnaces and only the silver recovered. The Orford Copper Company, one of the chief buyers of Cobalt ores, smelts them in short, small blast-furnaces, obtaining three products; crude arsenious acid, silver bullion 800 to 850 fine, and a speiss containing about 20% cobalt, 10% nickel, and 1% silver. The speiss is treated for the extraction of the silver and for the production of refined nickel and cobalt oxides. As regards the prices of arsenic and cobalt, arsenious acid is now only 2¼ cents per lb. in America, or one-half what it used to be, and cobalt oxide is 80 cents per lb. or one-third of its former price. There is every likelihood of the low prices stimulating the demand and extending the application of these two products. For instance pottery manufacturers should now be able to increase the use of cobalt oxide for counteracting the yellow colour in china-clay due to the presence of iron; it is only in the higher qualities of pottery that cobalt is at present added for this purpose. It is also probable that metallic cobalt will in future find a wider application in the production of hard steel, for its effect in this direction is even more notable than that of nickel. The application of cobalt to the manufacture of ordinary pigments and paints is also contemplated. We shall therefore hear more of the practical utilization of the by-products of Cobalt ores in the near future.

Anhydrite in Mineral Veins.—In *Economic Geology* for September, Waldemar Lindgren describes the occurrence of anhydrite, that is anhydrous sulphate of lime, in the pyritiferous veins at the Cactus copper mine belonging to the South Utah Mine and Smelter Corporation in Beaver county, Utah. In America anhydrite has never before been identified as a primary mineral though its occasional occurrence as such has been recorded in Germany, Austria-Hungary, and Sweden. The only previous allied occurrence in the United States is at the Old Abe mine in New Mexico where native gold is found embedded in gypsum which may be taken to be the product of hydration of anhydrite. The most common occurrence of anhydrite is in sedimentary strata where it has been deposited together with gypsum and rock salt. For a long time this anhydrite was supposed to have been derived by dehydration from strata of gypsum, but in recent years it has been shown that anhydrite may be obtained by precipitation from solutions of sodium chloride at 30° C. Mr. Lindgren describes the Cactus deposit in detail. The country is composed of a thick series of limestone and quartzite beds, intruded by a large mass of coarse-grained monzonite. The orebody consists of what is practically a stockwork, the ramifications of veins following the line of crushing and shattering of the monzonite. The principal copper mineral is chalcopyrite and much pyrite is associated with it. Here and there spots of chalcocite are found in the upper levels and also some bunches of tetrahedrite rich in silver. Occasionally galena and blende are found. The ores not only occur in the cement of the brecciated monzonite but are disseminated through the rock between the veins and on each side of the stockwork.

There is little water in the rock and sulphides are found quite near the surface. The gangue consists of tourmaline, siderite, specularite, anhydrite, gypsum, and quartz. The gypsum is the most abundant of these, and from the second level downward anhydrite is associated with it, being in the process of gradual hydration. The unaltered anhydrite is found in crystalline masses, the individual crystals being an inch or two in length, some of cubical shape but most commonly in tabular form. The colour is pale violet or purple. The miners and others familiar with the lode have taken it to be calcite or fluorite, and the author considers that the mineral is more often present in veins than is usually supposed. As regards the origin of the deposit, it is clear that it was formed after the consolidation of the intrusive monzonite, but its formation must have started at high temperature and pressure, the presence of tourmaline indicating this. Subsequently when the pressure and temperature became less, the carbonates and sulphates would be formed. If the ores were formed by ascending solutions as seems probable, a large amount of sulphuric acid must have been supplied by the intrusive magma. The lime may have been supplied from the limestones which once must have covered the monzonite before the present period of erosion. During the later part of the mineralization, the anhydrite may have been precipitated by a reaction between ascending solutions of sodium sulphate and descending solutions containing carbonate of lime. Recent experiments by A. C. Melcher have shown that the solubility of anhydrite decreases rapidly, a fact which would explain this reaction.

HYDRAULIC MINING AT BRISEIS.

Influence of Manganese on the Deposition of Gold in Ores.—The *Bulletin* of the American Institute of Mining Engineers for October contains an extensive monograph by W. H. Emmons entitled "The Agency of Manganese in the Superficial Alteration and Secondary Enrichment of Gold Deposits in the United States." Briefly the theory is that manganic compounds release chlorine from common salt in the presence of acid. The chlorine dissolves the gold and carries it away from the original point of deposition; subsequently the gold may be precipitated by ferrous sulphate in the absence of manganic compounds. Ferrous sulphate is always found in the neighbourhood of pyrite, so the reaction explains the presence of gold in pyrite deposits. This precipitation by ferrous sulphate will not take place if the dioxide or a higher oxide of manganese is present, for these compounds change the ferrous into ferric sulphate which is not a precipitant of gold. The author quotes experiments relating to the solvent power of weak cold solutions of chlorine and shows that their action on gold is quite appreciable within a short time. This theory of the migration of gold applies only to the action of surface waters descending through the upper parts of an auriferous ore deposit where the waters are cold, dilute, and acid. In deeper zones the waters lose their acidity, and then the manganese compounds are precipitated with the gold. Thus manganite, as well as limonite and kaolin, is frequently found in secondary gold ores. Moreover in the precipitation of secondary copper and silver sulphides, ferrous sulphate is generally formed, and consequently these sulphides often contain gold. The deposits in the United States which have been identified as containing secondary enrichments in gold are almost without exception manganiferous. By converse argument it is inferred that gold placers and rich gold outcrops will not be associated with manganese; and as far as observation has gone this supposition is confirmed. The author gives a vast amount of information about the reactions on which his theory is based, and he critically examines a great number of gold deposits in the United States in explanation of the theory.

BOOKS REVIEWED

MORE RECENT CYANIDE PRACTICE.—Edited by H. Foster Bain. Cloth, 8vo. 424 pages. Ill. San Francisco : *Mining and Scientific Press*. London : *The Mining Magazine*. Price 8s. 6d.

This book is a sequel to 'Recent Cyanide Practice,' which appeared three years ago and has proved eminently useful. It contains entirely different matter and is, in effect, a reprint of the articles on cyanidation contributed to the *Mining and Scientific Press* between October 1907 and July 1910. Among them are the detailed descriptions of many of the latest cyanide plants, including those of the Tonopah, Montana Tonopah, Goldfield Consolidated, Dos Estrellas, San Prospero, Yellow Jacket, Homestake, Simmer Deep & Jupiter, and other celebrated mines. The treatment of ore containing both coarse and fine gold is discussed in a series of contributions by twelve different specialists ; similarly the cyanidation of silver ores, the economy of all-sliming, the question of short zinc, the regenerating of copper cyanide solutions, tube-mill linings, and the all-important question of cost are discussed by competent writers, thus affording reliable data from a variety of sources. This feature of collaboration by many experienced metallurgists gives the volume a value not possessed by the book that is based on the experience of a solitary individual. Alfred James contributes an authoritative review, the value of which is increased rather than diminished by the criticisms that follow it in the latter part of the volume. A. E. Drucker gives several pages from his experience in Korea, C. W. Merrill affords invaluable details concerning the Homestake practice, and W. A. Caldecott throws light on several doubtful points. The Pachuca 'tank' or Brown agitator-vat is described and criticized by Francisco Narvaez and others. Authoritative detailed description of the newest devices, such as the Burt, Ridgway, and Oliver filters, and the Hardinge conical tube-mill, are to be found, together with an exposition of the basic principles of crushing by Courtenay De Kalb and E. A. Hersam. In short, the book is a precipitation of crystallized knowledge from the current technical thought of our day. To the busy man it is an up-to-date compendium of the latest word on cyanidation and to the student it is a mine of facts interpreted in the light of the latest theories. Numerous illustrations adorn the well printed pages. Finally, the reading matter has been carefully edited by a journalist of acknowledged competence. T. A. R.

MECHANICAL ENGINEER'S POCKET BOOK. — By William Kent. Eighth edition. New York : John Wiley & Sons. Price 21s. For sale by *The Mining Magazine*.

The first edition of this most useful pocket book was published in 1895, and in succeeding years revised editions have appeared with minor alterations and additions, some paragraphs being substituted in exchange for old ones, and extra pages numbered *a*, *b*, *c*, etc., being added here and there. Ultimately the necessity for an entirely new edition became apparent, and it was then decided to use new type throughout the work instead of trying to utilize the stereotype plates. This new edition is of great importance to the engineer, for his requirements have been met instead of those of the typographer and printer. The book has been enlarged by 300 pages, from 1200 pp. to 1500 pp. Much of the older matter has been eliminated and the tables are now set in smaller type. The author in his preface acknowledges gracefully the help given him by his son, Robert Thurston Kent, in the preparation of this new edition. We take this opportunity of recording our appreciation of the style in which this book is produced. Much has been heard recently about the 'Weight of Learning,' and mining engineers who have to carry their library with them rightly grumble about the heaviness of many books of reference. Kent's book weighs less than 2 lb. and measures 7 by $4\frac{1}{2}$ by $1\frac{3}{4}$ inches. The type is small but easily read, there are no wide margins, and the paper is thin and strong. Every publisher would issue all his technical books in this style if he dare. His reason for not doing so is that the average buyer and bookseller judges a book by its bulk rather than by the value of its contents.

TEXT-BOOK OF ASSAYING.—By C. & J. J. Beringer, revised by J. J. Beringer. Twelfth edition. Cloth octavo, 460 pages. Ill. London : Charles Griffin & Co. Price 10s. 6d. For sale by *The Mining Magazine*.

This book was originally published 31 years ago and has passed through eleven editions. It has had the largest sale of any book on assaying and still holds its place as the best general treatise on the subject. There are of course others that are more suited to the requirements of skilled specialists ; but a book containing complete records of variations and suggestions, and arguments relating to their particular applications and their relative speed and accuracy would be too bulky and detailed for the average man connected with mining. The present edition does not contain much new matter and is practically a reprint of the eleventh edition published two years ago. That edition was notable for containing a new chapter on the assay of tin ores, and it introduced the wet method developed by Mr. Beringer. It will be remembered that the author contributed to this magazine last year a useful article discussing the relative merits of this and other methods of estimating tin.

JOURNAL OF THE ROYAL INSTITUTION OF CORNWALL.—Part I., 1910. Octavo, 260 pages. Illustrated. Truro : The Institution.

This volume of transactions is of considerable interest to metallurgists, as it contains a presidential address by Richard Pearce dealing with the historical aspect of the smelting of tin ore in reverberatory furnaces. It is usually supposed that Becher, a German miner resident in Cornwall, first used the flame of coal for smelting tin ore, for he himself recorded this fact in a book written in 1680 or thereabouts. No evidence other than this has ever been found. A patent for a reverberatory lead-smelting furnace was granted in 1678 to Lord Grandison and one for a reverberatory tin-smelting furnace to Robert Lydall in 1702. In his presidential address Mr. Pearce published for the first time some old documents relating to a lawsuit about rights to certain processes in tin smelting. These proceedings were taken in the year 1713-4-5, and no mention is made at all of Becher's invention. Mr. Pearce argues that if Becher's process had been carried out in practice it would have been quoted in this lawsuit. He considers that on undisputed documentary evidence Lydall should be given the credit of first using the reverberatory furnace for smelting tin ore. In this adoption of coal as fuel, necessity was as usual the mother of invention. Charcoal was getting scarce, so some substitute had to be found for the old 'blowing-house.' Coal was then coming into general use for all sorts of purposes and it was applied to smelting without a blast. This fragment of metallurgical history is of importance, coming as it does from a past-master of the art.

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REVIEW OF MINING

INTRODUCTORY.—The average City man considers the General Election a nuisance and resents the interruption to business, but the suddenness of the dissolution had at least the merit of diminishing the period of political agitation. However, politics has not suppressed financial activity; for example, in November no less than £24,668,300 of capital was raised by 79 different companies, as against £21,599,700, also by 79 companies, a year ago. The November figures are double the average of the same month during the past 14 years.

Quotations for Rand shares have suffered from continued realization, on a small scale, by Continental holders, and Paris has also been trying to unload its Mexican mining stocks. Rhodesians have exhibited animation, but West Africans continue dull. The Australian market has benefited from the Bullfinch episode.

The price of silver has gradually declined during the last month and on December 10 stood at 25d., a penny lower than four weeks ago. The fall is due to several causes; one is the unfavourable position disclosed by the Indian currency returns, the stock of rupees being shown to be lower than usual at this time of year; another is the attitude of Chinese speculators, who, considering the general silver outlook disappointing, have been buying sterling exchange, and have thus caused sales in London by the China banks.

TRANSVAAL.—In mid-November the statistics of gold production and labour supply proved fairly satisfactory, and the effect of them was fortified by the Gold Fields dividend. The total yield of gold from the Rand during October showed an increase of 6248 oz. as compared with September, although the daily average was 494 oz. less, on account of the continued scarcity of labour. The production of ore was 1,868,718 tons, yielding 28s. per ton, at a cost of 17s. 9d., leaving an aver age profit of 10s. 3d. per ton and a total profit of £952,161. These results are uniform with the preceding months, the slight increase in tonnage being accompanied by a proportionately lower yield, lower cost, and smaller profit per ton, and a slight increase in aggregate profit. But the changes are insignificant. The labour statistics are more interesting. Out of the total loss of 2945 boys, 2097 were from the gold mines, the aggregate of available natives being 196,699, as against 205,709 in May. The Consolidated Gold Fields of South Africa declared a 3s. dividend, with a 2s. bonus, making the total 7s. for the year, being 35%, or the same as in 1909. Having regard to the unfavourable character of the Kaffir market during the past year, this should satisfy the shareholders.

Among the ill-defined causes for uneasiness, leading to depression in Rand shares, has been the report that under the Union Government the rate of taxation on mines would be increased. No mention of the matter is made by the Union Minister of Finance in his Budget speech, but it is announced by him that a general profits tax is to be levied on base-metal mines, graduated according to richness, and it is proposed to extend the 10% profit tax now paid by the gold mines of the Transvaal, to the diamond mines in Cape Colony and the Orange Free State. Whatever doubt may have lingered regarding the prospects of the East Rand Proprietary has been removed by the early declaration of a 20% dividend, making 40% for the year, as usual.

Rumours that the Simmer & Jack East was to be closed down gained currency by reason of Lord Harris's recent discouraging reference to operations in that mine, but the London

secretary states that the rumours are without foundation. Having regard to the scarcity of labour, it was readily assumed that the Gold Fields would be glad to transfer the Simmer East labourers to other mines of a more promising character. Assuredly if it is good policy to leave stoping ground that is not profitable, it is also logical to shut down mines that cannot earn a dividend, leaving the low-grade reserves for a better day and utilizing the human machinery elsewhere.

The growing tendency to avoid the milling of unprofitable ore, even when disguised by admixture with richer stuff, is shown in the quarterly report of the New Rietfontein, where stoping with rock-drills is to be discontinued in order to extract a narrower width of ore. In October the tonnage was smaller, but the profit larger. This is in accord with Mr. Marriott's contention.

Ore assaying 39 dwt. per ton for a width of 12 inches has been cut at 550 ft. on the Cyperfontein farm in the Klerksdorp goldfield, and is believed to be an extension of the West Bonanza reef. Another formation—resembling the Glynn's Lydenburg deposit—has been traced for 4000 yards 11 miles southwest of Pretoria.

RHODESIA.—The October statistics show a gratifying increase of production, namely, 13,303 oz. in excess of September; indeed the yield of 55,802 oz., worth £234,928, is better than any single month during the year. The increase is due entirely to the resumption of milling at the Globe & Phœnix, which produced £65,534, from 5116 tons, as against only £9488, from 601 tons, in September. At the Penhalonga the output was halved as compared to previous months this year, but the Wanderer, Selukwe-Columbia, Eldorado, and Gaika exhibit increases. The total number of productive mines was 173, as compared to 152 in September.

Crushings, to test the Shamva orebodies, should commence shortly, as the 5-stamp mill ought to be erected and ready for work. An outbreak of glanders in the Salisbury district delayed the transport of the machinery, otherwise results would have been available earlier. At the Giant Mines the results have been adversely affected by scarcity of competent native labour, and the disturbed character of the ground at the 7th level has led to the engagement of Mr. Corstorphine, who has made a non-committal report. Meanwhile actual mining will disclose the geological facts. We note, however, that the Gold Fields annual report discloses the fact, no less significant than geological evidence, that that company has sold the larger portion of its holding of Giant shares. The Wanderer company has an encouraging annual report and from the Hay mine an important discovery is announced. We note that Mr. H. E. Jones has made a joint inspection, with Mr. A. H. Ackermann, of the Selukwe mine, where exploratory work has been unsatisfactory. We commend this practice. Where two engineers co-operate sincerely in the effort to arrive at a correct diagnosis, the extra cost is as nothing compared to the service rendered. Meanwhile, it will be a good thing for the Rhodesian market when the Selukwe is closed down and ceases to be the subject of disconcerting cablegrams. The engineers mentioned advise that further development be discontinued and suggest that the mine be let on tribute.

It is announced that, in order to facilitate recruiting, the Native Labour Bureau is to raise £50,000 by an issue of debentures.

On November 19 the Rhodesian Exploration & Development Co., representing a consolidated capitalization of £1,500,514, issued an interim report giving particulars of progress at the several mines controlled by the company. This report is to be commended as giving the sort of information required by shareholders. Apparently the mines in the schist of the Enterprise district are full of promise, especially the Arcturus, Slate, and Homestead. Operations are distributed for

six miles along the strike of this gold-bearing schist. Most encouraging news is also forthcoming from the El Dorado, Antelope, and Selukwe-Columbia properties.

WEST AFRICA.—The statistics for October showed an output of 13,341 oz., worth £55,046, this being an increase of 1844 oz., or £7300, as compared to September. But the report of the United Exploration Co. was a more cheerful item, being accompanied by a dividend, which is the particular product most in demand. At the meeting Mr. Edmund Davis announced that the ore developed in the Prestea Block A. mine on September 30 amounted to 635,444 tons, averaging 43s. 9d. or about 11 dwt. per ton. Crushing is to commence in March, the delay being due to the slow construction of the Tarkwa-Prestea railway.

The Ashanti Goldfields is able to present an encouraging annual report, the profit having increased to £118,870, as against £44,790 a year previous. Unusually heavy rains have interfered with the erection of the new treatment plant, but it is now certain that in January the production will be raised to £40,000 per month. No sensational discoveries have been made in the Ashanti mine as was the case last year, but the ore reserves continue to be increased in a most gratifying manner.

MEXICO has been much to the front in an unpleasant way. We discuss the recent disturbances on another page. According to despatches from the local managers, the operations of English mining companies have not been seriously interrupted. Indeed ill-feeling is directed against American rather than British exploitation.

Mr. Alfred Main's interim report on the Mexico Mines of El Oro was a little disappointing in its forecast of time and money required for repairs to the North shaft, but it justifies the conservative policy of the management, which has refused to encourage the wild speculation at Paris, whereby Dos Estrellas, Carmen, and Mexico shares have been boosted recklessly. According to Mr. Main the exploratory work on the eighth level has been highly encouraging and the total reserve of ore in the mine has been well maintained.

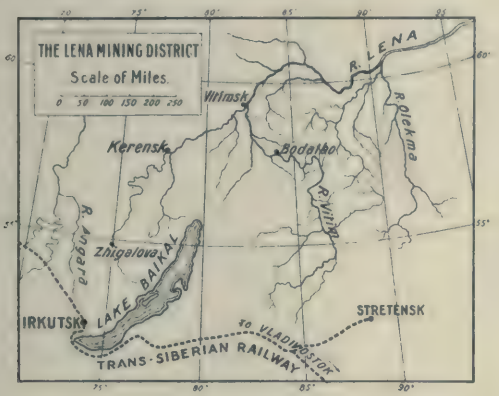
A company has been formed, on the initiative of the Exploration Company, to acquire the Santa Rosa mine, formerly operated by Victor Clement and later controlled by his widow, who is now the wife of Capt. Cloman, the American military attaché in London. The board of the new company consists of Messrs. R. T. Bayliss, R. M. Raymond, Capt. Cloman, and Lord Hardwicke. The mine is within 6 miles of Mazapil, in Zacatecas, and is a most promising property.

The Esperanza production for October showed the improvement that was promised, for, while 1195 tons less was treated, the profit was £11,566, as against £7176 in September. The consulting engineer gives details of the troubles that crippled operations recently and explains the declining yield of the sulphide ore, necessitating the treatment of a larger tonnage and the reduction of costs.

On November 14 Camp Bird shares were introduced on the unofficial market of the Bourse at Paris, the opening quotation being 41·50 francs, which, being above the London price, led to numerous arbitrage dealings. There is a large French holding in Camp Bird.

SIBERIA.—The various Russian enterprises in which British capital is involved have, by the exigencies of finance, become so interwoven that it is difficult to follow their relationships. However, good work is being done by several of them. The Russian Mining Corporation, whose chief asset is a large holding in Lena Goldfields, has declared a dividend equal to the amount of money actually called up, and a further dividend amounting to 5s. per share is promised. The Lenskoie, controlled by the Lena Goldfields, has gone into winter quarters, for frost puts an end to the washing of gravel. From now until April the gold-bearing product of the mines will be

stacked and stored for treatment in the spring. For the year ending October 13 the output of gold was 412,865 oz., worth £1,551,849, from which, it is estimated, a profit of at least £600,000 will be available, as compared with £519,455 during the previous year. Some critics wonder why a comparatively small proportion of these profits come to Lena shareholders; we would remind them that the figures relate to the working profit of the Lenskoie, and that this company is, and has for some time been, devoting much of its profit to the providing of working capital.



UNITED STATES.—The success of the sulphuric acid plant of the Tennessee Copper Co. is confirmed by recent figures. According to these the company now derives $420,000 of its annual profit from copper and $600,000 from the manufacture of sulphuric acid, which is sold for making fertilizer. Our New York correspondent refers to Guggenheim finance. Mr. Daniel Guggenheim states that it is the custom of the American Smelting & Refining Co. to sell its metal output before it is refined. The two Guggenheim companies handle metal products having a value of $190,500,000 per annum. Three of the new disseminated copper mines are expected to begin production shortly: the Miami in January, the Ray in February, and the Chino in July. None of them, however, will be in full swing until next summer, by which time their output will be felt on the copper market. The Chino, in New Mexico, is said to have 30,000,000 tons of 2·6% copper ore. The Miami has 18,000,000 tons of 2·75% ore, from which copper can be delivered at New York for 9 cents per pound, or £42 per ton. The new mill is to treat 750,000 tons per annum, but a daily capacity of 10,000 tons is mentioned as within future possibilities. This illustrates the big ideas current in this department of mining.

In Montana several gold-mining districts are doing well. At Radersburg, the Keating and Black Friday mines are shipping ore to Butte. In the Cable district, the Southern Cross and Orofino are prosperous. The Cable mine itself, one of the oldest in Montana, is controlled by H. C. and F. W. Bacorn, who are exploring over ground by diamond-drilling. In Judith Basin, the Kendall, Cumberland, and Gold Reef are productive. The Barnes-King, once the subject of a miserable fiasco, is being re-started under the management of J. L. Bright, a shareholder.

The output of gold from Alaska in 1910 is estimated at $21,000,000, or about the same as in 1909. The Fairbanks district is credited with $5,500,000, Nome with $3,500,000, and the new Iditarod district with $800,000. Next year Iditarod is expected to yield between $5,000,000 and $6 000,000. The Kuskokwim is coming to the front, but details are lacking.

CANADA.—We learn that the Yukon Gold Co., at Dawson, did well during the past season, but shortage of water hindered hydraulic mining, which has proved less satisfactory than the dredging on the lower flats. Another big water system has just been completed, by the North Fork Power Co., identified with A. N. C. Treadgold, the promoter of the Yukon Gold Co. The water is brought by ditch and pipe, 6 miles long, from the north fork of the Klondike river. The capacity of the system is 20,000 inches under a head of 235 ft., so that 10,000 hp. is developed. A new Marion dredge, having a capacity of 10,000 cu. yd. per day, was erected on the Boyle concession. It is electrically driven

and will supplement the successful dredge already in operation. Speaking generally, the mining industry of the Far North is prosperous and continues to be richly productive.

Portland Canal, which sprang into sudden fame during the Stewart or Bitter Creek boom, last July, is now quiet. But the quietness better indicates work than the shouting of excited speculators. According to Mr. W. F. Robertson, the Provincial Mineralogist for British Columbia, only one mine of any consequence has been opened up; the other prospects are not as yet productive "nor likely to be." This last phrase, of Mr. Robertson, has given umbrage to the people of the district, some of whom state that he has gone out of his way to express a personal opinion for which he had no adequate evidence. One of our correspondents insists that "a Government geologist should not be allowed to express any personal opinion on the future of a mining district or the valuation of ore." As a matter of fact, such opinions are rarely valuable because they are not based upon sampling, and they are used in prospectuses in such a way as to do harm. In this case the damage done was mainly to the feelings of claim-owners who are trying to develop mines, and who may be needlessly discouraged. Nevertheless, we believe that Mr. Robertson meant to do a public service by discouraging wild statements concerning the condition of the mining industry in the Portland Canal district. What is needed is less talk and more digging.

AUSTRALASIA.—Those who have an interest in the mining industry of Queensland will note with satisfaction that the Government in that State proposes to link the several disconnected railway systems, which now extend from various seaports into the interior. It is planned to unite these short railroads with one another, and with the main line from Brisbane to Sydney. Thus the trans-shipment to steamers will be avoided, with resulting saving of time and money. The private lines, built by mining companies, will eventually be acquired by the Government, so that all parts of the State will have a comprehensive and uniform system of communication.

Great Cobar shares have been acutely depressed by the statement concerning repairs to the shaft, compelling a cessation of production for several weeks. The shaft was sunk too close to the orebody and is now in the ore, so that sooner or later another main haulage shaft will be required. It is all the result of poor mining engineering.

Reduction in the profits of the Ivanhoe, from £20,000 to £18,000 per month, is a reminder of contracting resources.

The Golden Horseshoe is again the subject of controversy, Mr. Henri Kuss having cabled (on December 1) a report estimating the ore in reserve at 750,000 tons, averaging 9·3 dwt. per ton, from which 8 dwt. would actually be extracted. The manager, Mr. J. W. Sutherland, on June 30 gave an estimate of 903,592 tons, averaging 10·32 dwt. per ton. Since then 100,000 tons have been treated. Now Mr. Sutherland questions the accuracy of Mr. Kuss's figures and states that the latter did not examine the stopes, nor take any measurements or samples, with the exception of "a few taken roughly at the 2000 ft. level." The controversy is regrettable, but probably unavoidable. Our sympathy is with the manager. We have no reason to believe that a French Inspector-General of Mines would be fitted to make an accurate diagnosis of a big mine at Kalgoorlie, and we deprecate any estimates that are not based on careful sampling.

Among existing companies that have profited from the Bullfinch excitement are the Great Boulder and the Oroya Exploration. The Oroya Links started negotiations for some leases but found the price prohibitive. On Mr. Richard Hamilton's favourable report the Great Boulder Proprietary Co. acquired some claims in the district. It is well if similar useful prospecting ventures could be initiated

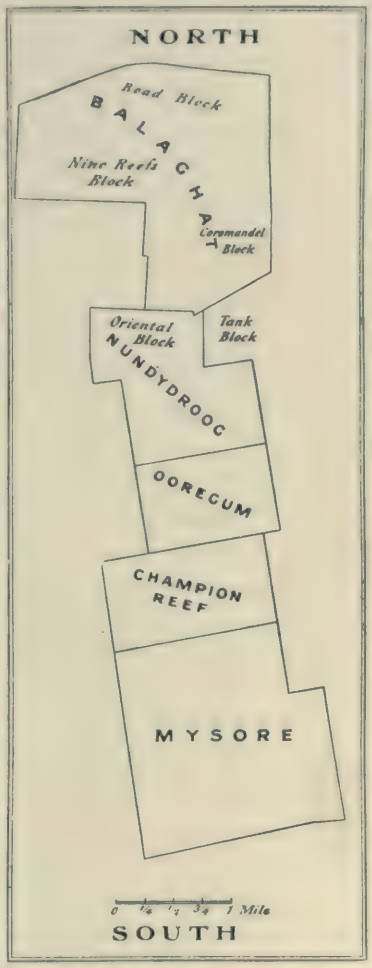
by experienced local men instead of floating heavily capitalized companies on mere expectations.

PRUSSIA — Telegraphic despatches state that gold has been discovered in the Eifel range, in Rhenish Prussia. At 5 ft. below the surface gold-bearing alluvium has been found by a boring, which has since pierced 45 ft. of similar material. Shafts are being sunk by two exploring parties. This however needs confirmation. Gold is widely distributed in nature, and it requires more than traces to make a mine.

PHILIPPINE ISLANDS.—Prospects for gold dredging are reported to be excellent, especially in the Ambos Camerines district, in Luzon, and also in parts of Mindanao and Mindoro. Several American companies are at work. An English company is exploring quartz veins in the Benguet district, in northern Luzon. The Benguet Consolidated, controlled by Americans, is operating a 3-stamp mill and making a small profit. Operations were hindered by a typhoon, which partly destroyed the plant. German engineers have been examining a copper property in northern Luzon. Indications point to an expansion of the mining industry, but careful investigation and expert advice is imperative, for the islands offer plenty of superficial evidence of mineral, some of which is likely to prove delusive.

INDIA.—During the early part of November the Kolar goldfield suffered from an unusual rainfall, and at several of the mines the lower levels were filled with water to such an extent as temporarily to suspend development work. The interruption, however, was not prolonged for more than a fortnight. It is not usual for this district to suffer from too much rain; the trouble is the other way.

The yearly report of the Champion Reef mine confirms the opinions expressed from time to time that recent developments have tended slightly to improve the general position. The dividend for the year ended September 30 absorbs £60,666, as compared with £52,000 during each of the two previous years. The output of gold was £441,255 from 186,680 tons, as compared with £436,097 from 172,378 tons the year before; the yield per ton is only one-half that of five years ago. The ore reserve is sufficient to keep the



mill employed for 18 months, and the average grade is rather higher than that of the ore milled during the past year. One of the most interesting points in connection with the policy of the company is that the new vertical 'Circular' shaft has been sunk to 2467 ft. and that it is to be equipped forthwith. This shaft will ultimately handle the whole of the output from the lower levels of the mine.

STATISTICS

Stocks of Copper in England and France.

	October 31 Tons	November 30 Tons
In England	71,280	67,327
In France	6,592	6,423
Afloat from Chile	3,250	4,250
Afloat from Australia	7,300	8,250
Total	88,422	86,250

Figures Published by American Copper Producers' Association.

Month.	Production.	Deliveries			Stocks at end of month
		Domestic	Foreign	Total	
September	53,357	28,795	33,529	62,324	66,426
October	56,459	30,274	30,441	60,715	62,170
November	53,282	27,143	30,100	57,243	58,209

Sale of Tin Concentrate at Redruth.

Date.	Tons	Value	Average
November 12	240½	£23,557	£97 18 6
„ 26	225¾	£23,316	£103 6 0

Production of Gold in the Transvaal.

Month.	Rand	Elsewhere	Total	Value
1910	Oz.	Oz.	Oz.	£
January	579,743	21,625	601,368	2,554,451
February	550,422	25,200	575,622	2,445,088
March	581,899	25,220	607,119	2,578,877
April	594,339	24,706	619,045	2,629,535
May	606,724	27,446	634,170	2,693,785
June	598,339	26,842	625,181	2,655,602
July	610,664	28,050	638,714	2,713,083
August	623,129	26,140	649,269	2,757,919
September	621,311	25,588	646,899	2,747,853
October	627,445	25,702	653,147	2,774,390
November	617,905	24,686	642,591	2,774,390
Totals (11 mos).	6,611,920	281,205	6,893,125	29,324,973

Cost and Profit on the Rand.

Month.	Tons	Yield per ton	Costs per ton	Profit per ton	Total profit
1910		s. d.	s. d.	s. d.	£
January	1,754,140	27 7	17 0	10 7	924,275
February	1,614,730	28 5	17 6	10 10	874,746
March	1,767,059	27 6	17 1	10 4	913,759
April	1,763,104	28 1	17 6	10 7	927,244
May	1,785,821	28 3	17 6	10 9	958,347
June	1,766,737	28 1	17 9	10 5	921,136
July	1,814,686	28 1	17 8	10 4	937,456
August	1,834,105	28 3	17 8	10 6	961,304
September	1,835,647	28 3	17 11	10 4	942,330
October	1,868,718	28 0	17 9	10 3	952,161
November	—	—	—	—	—

Native Labour in the Transvaal.

Month.	Gold mines	Coal mines	Diamond mines	Total
October 31	180,103	8,528	8,068	196,699
November 30	178,027	8,367	8,362	194,756

Production of Gold in Rhodesia.

Month.	1908	1909	1910
	£	£	£
January	199,388	204,666	227,511
February	191,635	192,497	203,888
March	200,615	202,157	228,385
April	212,935	222,700	228,213
May	223,867	225,032	224,888
June	224,920	217,600	214,709
July	228,151	225,234	195,233
August	230,792	228,296	191,423
September	204,262	213,249	178,950
October	205,466	222,653	234,928
November	196,668	236,307	—
December	217,316	233,397	—
Totals	2,526,007	2,623,788	—

Production of Gold in West Africa.

Month.	1910		1909		1908	
	Oz.	Value	Oz.	Value	Oz.	Value
		£		£		£
January	17,357	70,699	22,817	91,112	24,844	98,808
February	16,976	68,469	21,403	86,210	25,354	101,813
March	17,627	71,954	23,186	93,556	26,726	106,243
April	16,363	67,069	21,491	88,071	25,108	100,353
May	16,590	68,355	25,104	100,056	24,227	97,091
June	17,194	70,988	17,340	70,561	23,360	92,737
July	15,564	58,551	17,331	70,523	24,587	97,829
August	13,921	57,713	17,766	71,614	25,195	100,629
September	11,497	47,746	18,125	72,963	25,123	99,689
October	13,341	55,046	15,957	65,813	23,781	94,674
November	—	—	17,882	73,824	24,437	98,214
December	—	—	17,570	71,332	24,624	98,262
	—	—	235,972	955,635	297,366	1186342

Production of Gold in Western Australia.

Month.	Export oz.	Mint oz.	Total oz.	Total value
January	34,327	97,960	132,267	561,917
February	35,169	87,947	123,116	522,959
March	26,515	100,479	126,994	539,433
April	30,240	107,524	137,764	585,181
May	29,244	100,165	129,409	549,696
June	35,294	97,207	132,501	562,825
July	31,986	101,132	133,118	565,445
August	36,028	100,590	136,618	580,313
September	34,787	110,131	144,918	615,569
October	21,911	101,183	123,094	522,867
November	—	—	126,621	537,489

Other Australian Gold Production.

	November	Jan.—Nov.
	£	£
Queensland	113,800	1,380,000
New South Wales	82,947	758,891
New Zealand	144,708	1,826.105

Gold Output of Kolar District, India.

Month.	1909	1910	Month.	1909	1910
Jan	173,555	174,314	July	172,552	175.523
Feb	153,542	170,725	Aug.	173,318	175,356
Mar	170,106	176,231	Sept	173,279	175,687
April	170,578	175,539	Oct	173,496	175.719
May	172,156	175,387	Nov	176,027	175,604
June	171,585	174,923	Dec.	203,703	—
			Totals...	2,083,901	1,925,008

EDITORIAL

ON WEDNESDAY, December 21, the annual conversazione of the Royal College of Science and Royal School of Mines will be held in the college buildings, South Kensington, at 7.20 p.m. Sir Alfred and Lady Keogh will receive the guests. Old students should attend.

INTEREST in the Mining and Metallurgical Club has been heightened by the proposal to move the club quarters to the City, so that it can be made available for luncheon and tea. The matter is under consideration and may shortly be submitted at a general meeting of the members. Additions to membership are coming in rapidly and it is evident that the idea of a club is cordially endorsed, especially by those resident in foreign parts. Having formed an organization and a membership big enough to assure a reasonable income, it would be a great pity not to secure central quarters easily accessible to all the members.

THE LITIGATION between Messrs. C. A. Moreing and H. C. Hoover is much to be regretted. Two men so successful in mining and finance ought to be able to find ample scope for their unusual abilities, without going to law, in regard to the limit to be set upon their useful energies. Apparently the point at issue is whether Mr. Hoover broke a covenant not to engage in business as a mining engineer for a term of ten years, whether such a covenant was reasonably necessary for the protection of Mr. Moreing's business (in which Mr. Hoover was formerly a partner) and finally whether the exploitation of oil constitutes a mining operation. All of those are points capable of subtle argument, and we hope most sincerely that it will not be found necessary to elucidate them in court. Professional men ought to set a good example by settling such squabbles by arbitration.

MONTHLY lectures delivered at the Royal School of Mines under the auspices of the Students' Union form an interesting feature of social and scientific life of the new generation of mining engineers and metallurgists. Distinguished members of the profession are asked to give the students a lecture or 'talk' on subjects coming specially within their experience, and the young men therefore have the opportunity of getting into touch with the latest practice and the newest ideas. Last month we had the pleasure of attending the lecture given by Mr. E. P. Mathewson, who discoursed with racy humour on concentration and smelting at Anaconda. We would mention that the Union invites technical men to attend these lectures, and at Mr. Mathewson's evening we noted that several well-known practitioners were present, attending partly to acquire knowledge and thus prove that they were still students, and partly out of compliment to the lecturer and to his old college friend, Mr. W. A. Carlyle, the professor of metallurgy in the Royal School of Mines.

GENERAL SURPRISE is expressed at the unusual step taken by some of the French shareholders of the Mexico Mines of El Oro, a requisition having been signed by them asking that an extraordinary meeting be convened. At this meeting, which the directors have called for December 16, it is proposed by the requisitionists to demand the resignation of Messrs. R. T. Bayliss and J. H. M. Shaw, for reasons not stated. Pending the disclosure of the alleged grievances and the reply of the two gentlemen mentioned,

we express no opinion as to the matter of the controversy but we have something to say about the manner of it. French manners are proverbially good and when associated with oil they ought to be particularly suave. In this case they are crude to a fault. Mr. Bayliss has been long and honourably known as an administrator of mines, he has been a conspicuous success as chairman of the company, and his management of the Mexico mine has been decidedly creditable to English enterprise. Mr. Shaw is his collaborator at the Exploration Co.'s office and has worthily seconded his chief. Now, whatever the grievance of the French gentlemen, and the Pearson group associated with them, and however large their holding of shares, it is obvious that no justification is, or can, be offered for demanding the summary dismissal of the two gentlemen mentioned, without any sort of explanation. It is coarse work.

INTEREST has been aroused by the announcement of a re-arrangement of the business of Wernher, Beit & Co. In future the Central Finance & Investment Corporation, a company formed six years ago for the purpose of protecting the market interests of Wernher, Beit & Co., will undertake the active business of the firm in connection with general mining affairs, and also that of the allied firm in Johannesburg, H. Eckstein & Co. The official announcement relating to this matter in the Press did not describe the new arrangement in such a way as to be perfectly clear to the outsider. The fact is that the Corporation is to acquire the goodwill and some assets of Wernher, Beit & Co. and of H. Eckstein & Co., and will in future conduct all the active business of this group. The investments in established gold mining and other companies will remain as they are and not be transferred. The Corporation, whose capital will be increased from £3,600,000 to £5,100,000, will be represented in South Africa by H. Eckstein & Co. It has been rumoured that this re-adjustment has been effected for the purpose of allowing the heads of the firms, Sir Julius Wernher and Mr. F. Eckstein, to retire. This is not the case, for these gentlemen will continue their connection with the business. At the same time it is understood that the other members of the two firms will be afforded more opportunity for attending to the development of new properties and acquiring fresh business. What the re-arrangement really means is that in future negotiations in London in connection with new business will be done by the Corporation and not by the old firm. The consolidation will in no way affect the diamond interests of Wernher, Beit & Co.

ANOTHER case of 'salting,' this time in Mashonaland, serves to remind the consulting engineer that "it is better to be sure than sorry." Numerous methods have been recommended as a safeguard against any tampering with samples, but none is more to the point than the engagement of a trustworthy assistant. Often, on account of economy, an engineer will go to a mine alone with the purpose of making an appraisal. This is dangerous. No man should undertake an important work of sampling without, at least, one assistant whose probity is beyond doubt. Companies and syndicates will do well to allow—or even to insist upon—the engagement of such an assistant. In two cases that came to our notice recently, in regard to the examination of mines in Alaska and Mexico, respectively, this provision was made, in the one case by the engineer and in the other by the client himself.

ON ANOTHER page we discuss conditions in Mexico and publish a thoughtful article by an American engineer lately resident in Mexico. It will be noticed that he contemplates the peaceful annexation of the northern States, and we may fairly assume that, like other Americans engaged in mining

in Mexico, he has in mind the possibility of such disturbances as might require the presence of American troops for the protection of the lives and properties of his own countrymen. Under such circumstances the British Government would undoubtedly be pleased to place its own people under American protection and would allow affairs to take their logical course. The intelligent and patriotic Mexican has a right to resent such suggestions and we mention them only because it is best to recognize the tendency of events. We deem it best for Mexico to retain her independence under peaceful representative government, and we hold that the assimilation of the southern Republic would render acute the racial dyspepsia from which the United States already suffers.

WHEN Sir Julius Wernher presides at a company meeting he is apt to signalize the occasion by giving an interesting interim review of mining affairs in the part of the world in which the particular company is doing business. Thus at the annual meeting of Fraser & Chalmers he was pleasantly invited by Mr. Vere H. Smith to answer some leading questions on the outlook in South Africa. The replies were, in the main, optimistic. Sir Julius is of the opinion that the apathy on the Stock Exchange does not reflect any stagnation on the Rand; on the contrary, he interprets the lack of speculative excitement as due to industrial stability and the formation of consolidations that have emphasized the investment character of mining enterprise in the greatest of modern gold regions. He expresses perfect confidence in the new Government and refers to the conspicuous ability with which the individual States had been previously governed as a good augury for the efficiency of the Union administration. He acknowledges the scarcity of labour, of course, but the shortage is not such as seriously to cripple mining operations. We hope that is so, but it seems a trifle roseate. In regard to taxation, Sir Julius has no fear, believing that the general prosperity of South Africa is such as to preclude the necessity for imposing any additional burden on the gold mines.

Finches and Finance.

Western Australia has seen a revival of the glitter of a previous decade and we have been treated again to examples of the reckless finance that wrought so much ruin in the days of Whitaker Wright. Like those earlier performances the present excitement is based upon a mineral discovery of real merit. What harm has, or may, follow is due entirely to ignorance and exaggeration, partly unintentional, partly designed. In April some rich gold ore was found near Southern Cross on a lease called the Bullfinch. Two shafts were sunk, to 50 and 100 feet, respectively, and small shipments of high-grade stuff were made. The continuity of the ore between the shafts was not proved. On October 27 the financial Press announced that a big find had been made, and quoted some recklessly optimistic remarks by the Premier of Western Australia. On November 3 the prospectus of the Bullfinch was issued, due prominence being given to the Premier's statement, together with estimates furnished by those participating in the business. According to the most reliable of these estimates the mine contained £400,000 worth of ore, from which a profit of £250,000 was assured. On this evidence the 500,000 shares rose to over £3 each, and a valuation of £1,500,000 was thus given to a mine estimated to have a profit of £250,000 in ore, besides possibilities of an unknown character. On November 16 the Mountain Queen was offered to the public, with a capital of £125,000. This property consists of six claims on which enough work has been done to demonstrate good stoping-widths of medium-grade ore. Prospecting has been in progress for some time by the Oroya Exploration Co., the vendor, and the business

represented a little opportune liquidation on the part of a company that was organized last March to take over the assets of the old Oroya-Brownhill. The Mountain Queen flotation was reasonable, it was neither preceded nor followed by alarums and excursions, but was accompanied by a few plain businesslike statements. The East Bullfinch appeared on November 9, the shares being introduced at a premium, on a capital of £120,000. Two leases, wholly undeveloped, constituted the property. No engineer's report was attached. On November 23 the Bull Ant Proprietary issued a prospectus, with a capital of £200,000 and a few general statements of an unconvincing character. This may be regarded as a subsidiary of the Bullfinch Proprietary, for the vendors are the same. Incidentally the contracts as disclosed prove that a mine (1) bought, by cable, on November 14, for £15,000 in cash and £40,000 in shares, is (2) transferred on November 22 for £105,000 in cash, and is then (3) offered to the public on November 23 for £200,000. Finally, on November 28 the Golden Bullfinch was offered in terms of cynical effrontery. Ground covering 24 acres and acquired three weeks earlier for £5000 in cash is capitalized at £100,000. The testimony as to value is summarized by saying that the leases are "only half a mile from, and on the line of reef of, the Bullfinch Proprietary," and that "the width of the lode is 15 feet wide," which "in the opinion of the directors" is deemed to be "a very important feature, since the lode in the Bullfinch Proprietary is stated to run almost exactly the same width." No assays are quoted, nor is any evidence given that the 15 feet of lode contains any gold. The simple-minded are invited to assist in paying £100,000 for a claim having what a Cornishman might call symptoms of indications. It seems funny to some of us, but it may prove sad to others. In a cablegram received on November 29 it is asserted that one of the Golden Bullfinch leases had not yet been surveyed, only recommended, while the other had not even been surveyed. Yet on this half-hatched mine a capital of £100,000 is placed. While these five companies have been floated in London, the shares of an Australian company, capitalized at £100,000 and called the Great Chaffinch, have been bought and sold at a big premium. Concerning this potentiality of wealth we quote a cablegram, saying: "The latest news is that the width of the lode is 2 ft. with a pay-streak of ore rich in gold, the present width of which is 2 inches." The richness in gold is not expressed in ounces or shillings, nor in any unit known to ordinary people, therefore we leave it to our readers to calculate how rich the two inches must be in order to be stoped profitably. It is an easy calculation, but it ought not to have been necessary if the promoters of the Great Chaffinch were not great chaffers.

The main facts have now been outlined. To explain this campaign of promotion it is only fair to add that shipments of extremely rich ore have been made from the parent mine. During November 500 tons of ore, averaging 12 oz. per ton, were broken in the Bullfinch, besides two additional parcels of 20 and 45 tons, containing 11½ and 23 oz. per ton, respectively. To people wearied with 7 or 8 dwt. ore, and the mean profit to be derived therefrom, such stuff seems fabulous, for they do not consider how much of it is necessary to earn a profit sufficient to justify a valuation of £1,500,000. To pay back £1,500,000, plus interest, it is probable that at least £3,000,000 gross, or more than 20 tons of pure gold, is required. One might suppose that patches or pockets of specimen ore had never been seen before. The Londonderry, Bayley's Reward, and Golden Feather in Western Australia, the Shotover, Caledonia, and Moanataeri in New Zealand, the Hill End, Forbes, and Lucknow mines in New South Wales, the Etheridge, Palmer, and Mackay diggings in Queensland, are some of the names that rise like wraiths from a gambler's dream of former orgies. More money

has been lost through rich mines that were over-valued than in hungry wild-cats that never had a chance of becoming profitable.

In our last issue we referred to the wild talk of the Premier of Western Australia. His inexpert opinions were used in two prospectuses. This might have been expected. We quoted the exact words he used in our November issue, so we need not repeat them. We say again emphatically that the only opinion on a mine worth anything is that of an engineer who has sampled it, and preferably a mining engineer whose judgment has not been weakened by participation in the profits of promotion. Premiers, admirals, and archbishops are useful persons so long as they attend to their own business. We deprecate the part played, however innocently, by the Government Geologist and other officials. It may be within their province to warn the public against frauds, but when they lend their names to statements concerning rich finds about to be floated in hugely over-capitalized companies they aid in doing more injury than is done by a score of little puling wild-cats. Our Melbourne correspondent indicates that while the Premier of Western Australia was waxing hysterical over another 'Golden Mile,' the Premier of South Australia was advocating legislation to curb the pernicious activities of irresponsible syndicates. We venture to suggest that the two Premiers should meet at the inter-State boundary and hold a conference with a view to harmonious action. In the meantime Messrs. Richard Hamilton, W. J. Loring, and Malcolm Maclaren have expressed favourable opinions, based in each case on a brief inspection. We do not doubt the existence of rich ore, enough to warrant elation and vigorous prospecting, but we have seen no evidence to justify the capital issues that have been made. It is all premature. Prospects are sold as fully developed mines, and mere claim-areas are treated as prospects. A mine is not made by pegs, and a hole in the ground is not necessarily a treasure-vault. Even geological indications are not directly related to dividends. Such indications may justify the search for gold but they are not measurable in thousands of pounds sterling. The *Statist* may call attention solemnly to "the desirableness of understanding the geological nature of the country," but, after all, the most complete misunderstanding of "the geological nature of the country," would not matter if an adequate number of tons of rich ore were blocked out by systematic workings or other evidence were available to prove that the price of the claim was not excessive. All the flapdoodle about granite contacts and a kindly formation is as nothing when weighed in the balance of brutal experience against ounces of gold in tons of quartz. Finance may deal in fiction, mining is based on facts.

Mexican Unrest.

Recent events in Mexico give timely interest to an account of basic conditions in that country such as we offer at the hand of Mr. Theo. F. Van Wagenen, a mining engineer of wide observation and ripe experience. Most of those who are participating in the exploitation of Mexico's natural resources have shown themselves eager to belittle the outbreaks reported from localities so wide apart as Puebla, Torreon, and Parral. This is by no means strange, for any fear concerning the stability of the Republic would depress share quotations. For those who do not view the political conditions from the standpoint of the Stock Exchange, there does seem cause for anxiety. While the disturbances have been exaggerated in the American Press, it would appear to us that the significance of recent events has been unduly minimized in our own newspapers. As seen from a distance General Porfirio Diaz looms large and fine; the romance of his early career, his continued possession of power, from 1884 to this date, and the wonderful progress made by his country

during the successive terms of his presidency, all tend to awaken friendly admiration abroad, especially among those to whom the character of the Mexican system of government is of vastly less importance than such maintenance of order as will permit industry to develop without interruption. There are two sides to the picture. To the foreigner Diaz is a reasonable and forceful ruler with an amiable attitude toward concessionaires; he has encouraged the application of foreign capital and the systematic exploitation of natural resources that might otherwise have remained indefinitely unproductive. To the promoter this encouragement is evidence of enlightened patriotism. Under Diaz the United States of Mexico have grown prosperous; under him revolutions have ceased to be a constant hindrance to development; under him Mexico has become rich and respected. That is one side of the picture. On the other hand, the native Mexican says that Diaz and his friends have exploited the country in their own interest. The members of the coterie that surrounds the perpetual president of the Republic have had a good time and have been eager to co-operate with the promoters that flocked from the other bank of the Rio Grande. Order has been maintained with the ruthless severity of a Turkish pasha. Representative government exists in name only. That is the other side of the picture.

Other aspects may be cited. The professional class is willing to let things be, but the intelligent artisan is beginning to think for himself. He finds that he can do the work for which the imported American mechanic is highly paid. He asks for the same wages. He sees his country over-run by enterprising foreigners who show scant regard for his sensibilities. He is a half-breed, and is as proud of his Indian as of his Spanish blood. He has felt the impulse of democracy transmitted from the great country to the north and he dares to ask for a form of government that shall give him a voice, not a bribe or a blow. Finally, the native Indian, ignorant and dirty, lingering in peonage, is bullied alike by the American interloper and the *rurales*, an effective but brutal *gendarmerie*. Meanwhile the friendly onlooker may well conclude that the despotism of Diaz was well suited to the conditions as he found them a generation ago and that he alone for a long time stood between Mexico and recurrent revolution. But the times have changed and the Mexican people with them. Autocracy is out of date. The exploitation of Mexico may have been encouraged from patriotic motives, but it has enriched a motley crowd of promoters, chiefly Americans, who unfortunately have not yet learned to distinguish between the brown races and the African negro. The contempt for the 'greaser' is matched by the hatred of the 'gringo.' Vast areas are alienated to the foreigner. The Governors of various States participate in the profits accruing. The elections are an undisguised farce. Diaz re-elects himself. He distributes his favours unequally, so that while Oaxaca, where he was born, is benefited, another State, such as Guerrero, is treated so scurvily as to revolt. Repeated incidents of this kind have provoked general unrest.

Another reflection is permissible: Diaz is old, he begins his sixth term as President at the age of 80. A despotism, however beneficent, has an inevitable drawback: it does not perpetuate itself. A limited monarchy, even though it be a weak compromise in the way of human government, has one obvious advantage: it does perpetuate itself. Thus the death of a king nowadays leaves no administrative hiatus, but the sudden end of a despot's career is the signal for disturbance. Diaz would do a patriotic service by resigning before the chill hand of Death is laid on his shoulder. It is true a vice-president was selected with this contingency in view, but Señor Ramon Corral is not deemed capable of per-

petuating the present administration. Señor José Y. Limantour, a financier of world-wide fame, would have fitted the post, but he is of French origin and wisely declined. General Bernardo Reyes was mentioned, but his friends became too vociferous and he was promptly banished from the country. The tendency has been to eliminate any really strong man from the succession. Reyes is in Switzerland, Limantour is in Paris, Madero had to cross the border. The last of these, Francisco Madero, is mentioned as the leader of the late outbreak. He was a candidate for vice-president at the recent election. A young man of 30, he is a member of a highly respected family and his father controls the Torreon smelter. Apparently he made a big blunder, for the revolt was a fiasco. Yet it conveys a warning. The Mexican Government may send cablegrams to London and Paris informing its representatives that the reports are grossly exaggerated and that all is well. All is not well and no good can come from refusing to face the facts. We believe that the stability of Mexico is dangerously dependent upon the life of an old man whose autocratic administration has made no adequate provision for an efficient successor.

Secondary Enrichment.

On another page we publish a most suggestive article by Mr. Horace V. Winchell, a mining geologist who by heredity and personal experience is peculiarly well qualified to write on one of the most fascinating of the many problems presented to the mining engineer when engaged in an appraisal of ore deposits. He explains why so many of the showings discovered in northern latitudes prove, when tested by mining, to be but superficial enrichments—the slight cover of cream that covers the thinnest of milk. Briefly, the decomposition of rock and the downward penetration of soluble metallic salts in advance of erosion may lead to the formation, in a southern climate, of secondary enrichments large enough to constitute the bonanzas for which the miner patiently seeks ; but in sub-arctic regions generally, and in those of North America in particular, the oxidation of the surface extends to a depth of a few inches only. In these northern regions the glaciated rock bears witness to the fact that the abrasive action of the great ice-sheet of a not remote Glacial period has removed the decomposed covering almost as fast as it was formed, and it was formed slowly because Nature lacked its most powerful weapon of decay, namely, the alternations of heat and cold, of sun and frost, and more particularly that irresistible wedge offered by moisture in its expansion and contraction between zero and 39° F, the temperature marking the maximum density of water. But we shall leave Mr. Winchell to tell his story in his own words and we commend it to every mining engineer desirous of information having obvious application to the valuation and estimation of prospects.

In our Précis of Technology we give abstracts of two papers on economic geology read recently before the Institution. They relate to such celebrated ore deposits as Rio Tinto and Mount Morgan. At the Spanish mine it has been shown by Mr. A. M. Finlayson that chemical migration of the copper has played an important part in the distribution of the rich ore, and this fact influenced the exploitation of the mass of cupriferous pyrite, for it has been ascertained that the Romans worked down to the bottom of the shallow zone of maximum secondary enrichment and missed such orebodies as were capped by a thick gossan of leached ironstone. Under this gossan comes a layer of earthy ore notably rich in gold and silver, undoubtedly concentrated there, at the base of ground-water, by secondary precipitation. It is supposed that the precious metals were derived from the oxidized pyrite and were dissolved in ferric sulphate, which, in turn, was reduced to ferrous sulphate by the

sulphide ore of the deeper horizon. Similar occurrences have been noted in the Ural region and in Norway, as well as at Mount Morgan. This, after all, is a glorified gossan of immense size, the remainder of a big mass of rock formerly impregnated by gold-bearing pyrite, which also contained copper, and now appears as a silicious matrix, bleached by sulphurous solutions and eroded by weathering so as to form a knoll in the midst of the Australian bush. Mining operations have dissected the orebody and uncovered its roots, as it were, so that the character of the deposit can be diagnosed with some confidence, particularly now that Mr. J. Bowie Wilson has reviewed the evidence in the light of his intimate knowledge of the mine workings and their geological environment. The sudden transition from oxidized to sulphide ore is probably coincident with the change in the country rock that was thus mineralized, the orebody reaching through quartzite into greywacke, and both of them being traversed by the dikes, which, in turn, on cooling and shrinking, served as the conduits for thermal waters. Then came the secondary, but all-important, processes of enrichment and impoverishment whereby the iron and copper were leached, the copper migrating to a horizon at the base of the groundwater, there to form the ore that has changed the Mount Morgan from a high-grade gold mine to a low-grade copper-gold enterprise. The gold was partly leached and transferred downward, but partly concentrated in place, surviving the corrosive action of the sulphurous waters formed from the oxidized pyrite. That which went into solution was soon precipitated by the ferrous sulphate and the sulphide of a slighter deeper level. Even twenty years ago the appearance of the deposit suggested to the present writer that it was possibly the cap of a mass of copper ore, but at that date the theories of secondary enrichment had not been enunciated, and an idea that might have been scientifically developed was allowed to drop. It is not often that the exploitation of an ore deposit is carried so deeply as to disclose evidence so complete as that available at Mount Morgan. There, as at Rio Tinto, the scientific interest of geologic investigation is splendidly enhanced by its commercial importance.

Western Australia.

The recent discoveries near Southern Cross have given pleasant prominence to the youngest of the Australian States. This renders timely the address delivered by Mr. A. Montgomery, the State Mining Engineer, before the Royal Society of Arts on November 29. We would have liked to publish his address in its entirety but the exigencies of space prevent us from giving our readers more than a small portion of a thoroughly conscientious and highly intelligent effort to place before the public a general description of the conditions affecting the mining industry of Western Australia. The State is to be complimented on retaining the services of so competent an official and we hope that his efforts to revive genuine interest in London will have proved entirely successful. Just at this time, however, the public needs more of caution than incentive to participation in Westralian exploitation, for the Bullfinch discoveries have been followed by the usual wild excitement and reckless finance. Even rich mines will fail to yield a profit to those that own them if they are purchased at two or three times their real value, as determined by careful and unprejudiced examination. Dividends and outputs of gold are not the only measure of profit and loss. Mr. Montgomery, for example, makes an analysis of the gold yield and proves that the productive mines have made a handsome return on their nominal capital and upon the money actually expended on them, in purchase and equipment. But he fails to face the fact that nominal capital does not begin to express the sum of money on which mines

have to pay interest. The business of mining includes two processes, namely, the winning of gold from the ground, and the extraction of money from the unwary, credulous, and greedy. One is legitimate, the other illegitimate; unfortunately we cannot shut our eyes to the fact that the first is often the motive that facilitates the second. The first is necessary, the second unnecessary. In the end the captain of industry suffers from the *chevalier d'industrie*. The capital involved—we do not say 'invested,' for mining is essentially a speculation — far exceeds that which is required to find and equip mines. As things are, a mining enterprise entails the expenditure of money, not, for example, in Western Australia alone, but in London also. Possibly the fiascos that disgraced the boom of an earlier decade were debitable largely to the vagaries of persons not resident in the State, but the iniquitous schemes could not have been perpetrated without local assistance. The spoofery was not wholly exogenous. All the more reason why responsible people should exercise care in the handle they may give to similar performances today. We refer to the Premier's *betise* elsewhere. The State Mining Engineer, naturally, deals in safe generalities, and therefore fails to be convincing in his advice to investors, but he makes several excellent remarks on prospectors and prospecting. Obviously the supply of local capital for exploratory work is limited, for the country is scantily populated and fully immersed in the development of existing enterprises. Hence the man who needs money to develop a promising mine is prone to turn to his friends in London. These can well afford to embark in the speculation if they do so with their eyes open. Unfortunately they are usually in a hurry to liquidate their liability by inviting the public to put their money on a pig in a poke. A mere prospect is hailed as a mine, a capital that smothers the enterprise at its birth is imposed, and three times as much money goes to promoters sitting at their desks as is paid to the prospector or is provided for the equipment of the property. Evidently there is need for better methods. Speculators treat prospects like developed mines and burden them with an intolerable debt at the very start. Of course, the appraisal of prospects is notoriously difficult. Even experienced engineers dislike the responsibility. Moreover, a promising outcrop or a good-looking prospect-hole thousands of miles away may not warrant the sending of a high-priced expert from London. To overcome this difficulty it is well to engage the services of engineers resident in the locality, or near it. Another method is to form prospecting syndicates, consisting partly of local men in touch with prospectors and partly of capitalists in London or elsewhere willing to speculate in such ventures. Indeed, such syndicates or private companies are the best links between the men who find mines and those who wish to exploit them. The search for mineral deposits under such conditions may be made highly profitable without exploiting public credulity. Profit is the aim of mining, of course, but that does not entail misrepresentation. Honest mining needs no victim on its altar.

Consolidated Gold Fields.

The report of the Consolidated Gold Fields of South Africa for the year ending June 30 is, as is usually the case, a document interesting to a wider circle than "the honourable proprietors" as Lord Harris, for some recondite reason, calls his shareholders. The result of the year's work, if less brilliant than in some previous periods, is sufficiently satisfactory. After payment of preference dividend, a total disposable balance of £979,483 is left; of this £200,000 was written off investments, £79,483 was carried forward, and £700,000 was distributed among the deferred shareholders, while the balance-sheet shows an excess of cash and cash assets of £1,062,486. This is a solid

performance at which "the honourable proprietors" at the general meeting showed no disposition to grumble. Nevertheless there are one or two aspects of the report to which the wider public will do well to pay attention. Apparently a departure has been made this year in the rule, which the chairman indicated last year, of not distributing in dividends more than the aggregate amount received in dividends from investments and which he described as "normal receipts." Lord Harris's explanation of this departure was quite satisfactory; obviously in the case of a company occupying a position so strong and liquid as the Gold Fields, there is no reason why in a year in which it is able to set aside £200,000 against wasting assets, it should not distribute an amount somewhat in excess of the sum it has actually received as interest on investments. It would be interesting to know what proportion of profit was derived from normal receipts and what from the sale of shares; but upon this point the report, in other respects a model of lucidity, is silent. There can, however, be no doubt that the decrease in dividends was considerable. Thus we find that the profits from gold mining, after allowing for the renewal and replacement of machinery, at those mines on the Witwatersrand known as the Gold Fields group amounted to £1,354,045 for the year ending August 31 last, as against £1,641,090 in the corresponding period of the previous year, and it is fair to assume that this decrease of about 17½% corresponds roughly to the decrease in revenue from the company's own investments. Judging from his speech at the general meeting, Lord Harris seemed to think that the decline in revenue from investments was due to a temporary set-back in the crushing mines of the Rand such as had been clearly foreseen. It is difficult to contest this view; but it is not altogether easy to conclude that the factors which led to increased cost and decreased profit during the last twelve months are of a temporary character. The working costs over the whole Rand in August of this year averaged 17s. 8d. per ton, as against 16s. 9d. in August of last year, while on the mines of the Gold Fields group this item increased from 14s. per ton in 1909 to 15s. 2d. in 1910. It is doubtful whether the figures of 1909 will ever be appreciably lowered. Here and there, no doubt, methods will be improved, or processes perfected; on the other hand taxation is not likely to be lessened, and the conditions of mining as greater depth is attained do not make for economy, while over and above all is the chronic shortage of labour. This, of course, is incomparably the most serious factor of all, and it is impossible to discern any basis for optimism as regards prospects in the immediate future. According to Mr. H. H. Webb, the consulting engineer, the supply has increased by 70,000 during the last 11 years, and "the additional requirements for the next twelve months, to make up the present shortage in the present operating mines and fulfil the requirements of the expanding companies, amalgamations, and new companies coming on, will call for probably another 70,000 at least in addition to those already employed." It may be predicted with considerable confidence that this fresh army will not be forthcoming, and indeed nowhere either in the report or the chairman's speech is any reasoned hope expressed that it will be. The fact is that the limits of the available labour supply in South Africa have been nearly reached, and only the splendid reproductive powers of the natives themselves can be relied upon to enlarge them in the future. Pending this gradual replenishment the demand will go on increasing. Agriculture, public works, railways, every fresh development in South Africa is calling for "boys" in increasing numbers, while Rhodesia—where a shortage also exists—will inevitably divert an increasing proportion of the supply. An impartial consideration of the facts seems to compel the admission that the prospects of any

important reduction of the working cost below the figures of 1909 is improbable; and if Mr. Webb, who speaks with the authority of great experience, be correct in stating that "a value of about 5 dwt. is a grade which will eventually represent an average over a large area of the Rand, especially in the deeper sections," it is only an indurated optimist who will be able to discern in the margin thus foreshadowed any remnant of the glamour that previously surrounded the Witwatersrand, and which has so powerfully affected the imagination of the speculative public for nearly a generation.

Undoubtedly profits, and large profits, will continue to be made, and there is no reason to think that the Rand will cease to maintain its pride of place as the premier gold-producer for many a year to come. None the less the report of the Consolidated Gold Fields seems to mark definitely the passing of an epoch. It reads like an acknowledgment of middle age, that interesting period when a man first begins to realize that although a long, useful, and honourable career may lie before him, the llusions and the youthful feeling of boundless possibility have fled. Working costs at 14s. and an average grade of 5 dwt. may, with care, represent a respectable margin and even an aggregate of profit vastly superior to that shown in the early days, but none the less the glory has departed. The consciousness of infinite potentiality, the feeling that, if the outcrop disappointed or was nearly worked out, there was an endless vista of deep and ever deeper horizons awaiting exploitation and flotation is gone; all the hazy optimism of the Stock Exchange has been definitely superseded, and it behoves a great financial corporation like he Gold Fields to recognize the fact. It has done so. For some time past it has followed the policy of tentatively acquiring interests outside the Rand, but within the last two years or so the pace has quickened perceptibly. Today the outside interests are of considerable magnitude and importance, and it may be confidently predicted that they will increase. A considerable organization has been created in Rhodesia and a large number of prospects of varying degrees of promise are being opened; but the one interest of sufficient importance to call for special mention is the Shamva, to which Lord Harris referred as "a large low-grade proposition, which may prove to have gigantic possibilities," a cautious comment that contrasts refreshingly with the loose and facile optimism current regarding the property at the time of its flotation.

Regarding West Africa, the Chairman indulged in no predictions; but he evidently shares the view expressed in these columns last month that the turning of the long lane of stagnation has been nearly reached. The rate of progress depends mainly upon labour and the living conditions for employees, and with regard to the latter we note with satisfaction that Lord Harris specially emphasized the efforts that are being made to improve the food supply. A satisfactory account was given of the progress of the Lena Goldfields, and hopeful reference was made to the company's interests in the United States, more particularly in power-producing companies, which appear to be of some magnitude and which have been further increased since the close of the financial year. On the whole, the management may fairly be congratulated upon having recognized in good time the necessity for extending the sphere of its original operations and upon the results that have so far attended this wider policy. John Bright once said that the success of the National Provincial Bank was due to the fact that its Board was composed not of too many financial geniuses but of "sound men of business, with just the requisite amount of imagination, and no more." Perhaps something of the sort might be said in recent years of the Consolidated Gold Fields. Its founders and first executive officers were men of marked and original ability, and considering that they started by securing a large

and valuable area of the Rand, the wonder, perhaps, is that the results of their efforts as expressed in dividends were not more considerable than was in fact the case. Of late years the position has in many respects become more difficult, involving on the one hand a courageous extension of policy, and on the other calling for the constant exercise of restraint, sobriety, and judgment. In the balanced account which the Chairman gave of his stewardship and that of his colleagues there is clear evidence that these qualities have not been wanting.

Gold Mining in Nova Scotia.

Our friend the *Canadian Mining Journal* in a recent issue discusses the present condition of the gold mining industry in Nova Scotia as viewed by the editor, Mr. J. C. Murray, who has recently visited the Province. By way of summary he says: "The conviction is being brought home more and more to us that Nova Scotian gold mining will pay the private venturer (provided he be competent), where it will not in many cases yield sufficient profits to the joint stock company." We demur to 'venturer,' believing that 'adventurer' is the word required, but we do appreciate the fact that our contemporary has hit the nail on the head, and we are quick to express agreement because much the same recommendation was made by the present writer five years ago when the Government of Nova Scotia asked for his advice. The editor of the *Canadian Mining Journal* ends his leader by saying: "The gold is there. It remains for the mining engineer to show that the profits are also there." That rather begs the question. Between 'gold' and 'profits' there is a most necessary link which can be expressed by the words 'sufficient gold.' There is gold in the sea, and there is silver in the moonbeams.

In the early days of gold mining in Nova Scotia there were many enterprising and experienced Cornishmen who knew enough to follow the ore. Milling methods at that time were crude, it is true; they were crude everywhere; there has been much improvement since, but as regards mining itself, that is, the finding and then the extraction of ore, it is not too much to say that methods have deteriorated. Later operators, especially the men interested in company ventures, giving them the use of other people's money, have had a fine-and-large policy of sinking vertical shafts and extending workings not on ore but with a view to an eventual development of orebodies the shape and behaviour—nay, even the existence—of which was only surmised. Hence sad blunders. The old miner, willing to stick to facts, would first find the outcrop of pay ore—not of quartz or slate—and, recognizing the restricted character of it, he soon learnt that outside of a particular portion of the vein—his pay-shoot—the quartz was so poor as to yield no profit. He sank a prospecting shaft, using a 'whim' or a 'whip' when the windlass became inadequate, and then, having proved a small tonnage of ore, he set up his 10-stamp mill. By underhand stoping he followed the shaft as it was deepened and by keeping the product of the stopes apart he tested the richness of the ore, milling separate lots of it. By this method he ascertained that the shaft had penetrated below the shoot, the stopes in one direction being rich while they were poor in the other direction. Thus he obtained the data that gave him an idea of the course of the ore, that is, the pitch of the shoot. Subsequently, he sank a new shaft to cut the same shoot at a greater depth and he then stoped out another portion of it. When the ore 'petered out,' he 'quit.' In most cases this was the part of wisdom; in rare instances he gave a chance to a more venturesome operator.

The modern method is more flamboyant. If a small mine of 10 dwt. stuff has been opened up and a 10-stamp mill is extracting the gold

at a nice profit, the owners get an itch to make a big thing of it, they discover that they have lots of ore assaying $2 per ton, and assume that by building a 40-stamp mill and quadrupling their output, they can create a large low-grade enterprise out of a small affair. They make a big splash, crush a large tonnage of quartz, afford a living to a number of worthy citizens, and distribute shares among a number of persons as deluded as themselves. A fiasco ensues, and a good little mine has been spoiled in the silly effort to make a big one. It is a fact that gold mining on a large scale has rarely proved profitable in Nova Scotia, and the probability of developing such enterprises has been decreased by the experience of recent years, because the evidence does not favour the idea of a repetition of the ore-shoots in the underlying quartz formations. On the other hand, we are of the opinion that operations on a small scale, conducted by working miners or by intelligent individuals, without the investment of large sums of money, either in equipment or exploration, but based upon local knowledge and skilful prospecting, are likely to prove remunerative. We deprecate strongly the efforts made, chiefly by those who spend money lavishly and improvidently, to belittle the local syndicates and parties of miners who have found and exploited most of the profitable mines of Nova Scotia, and we advise the Government to foster this form of domestic enterprise, instead of making half-hearted attempts to play into the hands of reckless promoters.

How to make Engineers.

In a recent issue we ventured to give some advice to students about to graduate from Schools of Mines. The instruction to which they have submitted is a preparation for the work of engineering, but it does not make them engineers. They have only learned how to become engineers; to fulfil the purpose of the training they have undergone they must serve the apprenticeship of experience. The question then arises as to the nature of that apprenticeship. It is an old problem, changed in form but not in substance by the later relations of education to industry. We note that the subject was discussed recently before the New York division of the Mining and Metallurgical Society of America. Piquancy was given to the discussion by a friendly argument between the mining professor and the mine operator, as represented respectively by Mr. H. S. Munroe and Mr. J. Parke Channing. Fortunately it is no longer necessary to waste time in emphasizing the advantage of technical education; the least educated recognize the need, the best educated apologize for the incompleteness of their preparation. The clotted cant about the 'practical' man and his superiority to the merely learned is now as dead as the dodo; for we now see luminously that in the context of the old argument the word 'practical' was a veiled synonym for 'ignorant.' We ask nowadays for the experienced, not the practical, man; recognizing that only by experience is academic knowledge made fruitful, while only by reasoned theory is rule-of-thumb rendered intelligent. The question then arises as to how the young graduate from a technical college is to gain the necessary experience. The roads to his destination as an accomplished mining engineer or metallurgist are many; some are fortunate enough to find it straight and unimpeded; others are fated to encounter obstacles, but if these are overcome they will be the better for the trial. Many will see short-cuts and will take them in disregard of the proverbial danger of such deviations from the trail that leads to efficiency. The first employment given to the student may take the form of manual labour, of a clerical position, of assistant to the assayer or surveyor, or of a sampler underground. Concerning these beginnings it can be said that the assay-office of a mine is apt to be a blind alley leading nowhere, although at a smelter it offers a ladder

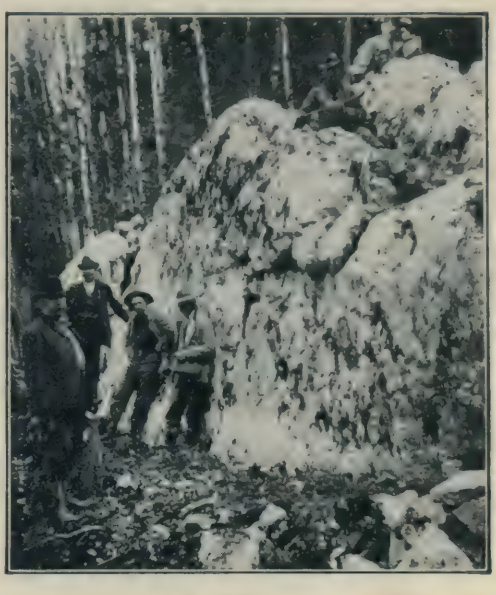
to promotion. To the metallurgist the analysis of ore underlies the formation of furnace-charges and is the very basis of his operations; to the miner the assay of his ores is an indication merely of their value, and at most mines the uniformity of the ore soon renders the assaying operation purely mechanical. The surveyor's office is a better ante-room to advancement, for the measurement and mapping of workings affords plentiful opportunity for observation, not only of lode-structure, but of underground operations. Similar chances are given to the samplers, whose work has now won proper recognition as an important branch of mine administration. Moreover, the young fellow who has learned how to take a sample properly is apt to be engaged by the engineers who inspect mines, and thus he gains an opportunity to enlarge his knowledge of conditions governing economic mining. For clerical positions the technical aspirant will have no fondness, yet a familiarity with cost-books, accounts, and the financial records of a mine is essential to a thorough preparation for mine management. Finally, there is the apprenticeship of manual labour, as a miner, a trammer, a timberman, or a winch-man. For those possessed of the requisite physical strength this preliminary training is invaluable. If a young man has the necessary sinews he cannot do better than go through the laborious training first of a workman, then of a foreman, with hope of promotion to a superintendency. Nothing is better; nothing is harder. Unfortunately intense physical exertion deadens mental activity in most men; only those of super-abundant vitality can combine the muscular exertions of a labourer with the alert intelligence of a student. In plain words, a young man who has done his shift in a mine for eight hours during the day is too weary to read at night or even to observe keenly by day. Nature impels him to eat and sleep during the intervals of exhausting manual labour. Thus the young fellow who becomes a good miner, timberman, or trammer, and is on his way to becoming a foreman, is apt to lose the sensitiveness to mental impressions that is necessary to the acquisition of technical knowledge. A few survive the trial and are fitter for it; most succumb, and are the worse for the experience. In short, not many graduated students can go through the probation of this type of 'practical' work without suffering both mentally and physically. Moreover, it takes time; and time is the essence of this problem. If the duration of a human life were conterminous with a century, then we would be warranted in giving a young man ten years at college, five or six years of the brutal realities of labour in mine, mill, or smelter, and then ten years of apprenticeship to an engineer, before expecting him to earn his living. But "art"—the art of mining—"is long and life is fleeting." We must do the best we can within narrow limits. For those that can endure it, it is well to get in touch with actualities by working as a labourer, for a while. For others it is waste of time and strength; to them the modified exertions of a sampler or chain-man are enough; to a few the easier chance of office-work may suffice to win promotion. But this much is certain: those who miss the preliminary training and are pitchforked into positions of trust too early will come to grief sooner or later, and preferably sooner, so that the lesson may be given before it is too late. We deprecate strongly the modern tendency of youngsters acting as aide-de-camps to well known engineers for a year or two and then posing as 'consulting engineers.' Such avoidance of the proper line of promotion is dangerous, as much to the man himself as to the operations directed by one so little equipped for large responsibility. The only way to become a capable engineer is to undergo as thorough a preparation as time and money will permit; the most complete preparation is imperfect, the frankly incomplete makes a young man not an engineer but an adventurer.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

TORONTO.

Porcupine.—There is every indication of an active winter in this district, and great preparations are being made for a rush of traffic as soon as the winter roads are passable. Work has been begun on the new electric road, which will connect the camp with the Temiskaming & Northern Ontario Railway, and in the meantime large quantities of machinery and material are being shipped for transportation by sleighs from Kelso, the nearest point on the railroad. The Dome has ordered a 40-stamp mill adapted to a patent process, much in use in the West, consisting of a double amalgamation, re-grinding, and cyanidation. The camp has lately been visited by a number of prominent mining men and financiers, including William Frecheville, of London, past president of the Institution of Mining and Metallurgy, and Dr. A. L. Simon, a noted Anglo-French authority on mining matters. Mr. Frecheville, in an address given at Toronto, stated that in the course of a cursory inspection of the district he had seen enough to satisfy himself that there were already two mines in operation that would certainly be dividend-payers, in addition to many most promising prospects. A large number of sales are reported. The six Herlehy-McPharland claims, lying about midway between the Rea mines, now controlled by the Consolidated Gold Fields of South Africa, and the Dome, have been taken over by a New York syndicate, which will proceed with development work at once. Seven veins have been found on this location; one 8 ft. wide shows free gold. The Davidson claims, five in number, in the northeast of Tisdale township, formerly under option to M. J. O'Brien for $130,000, have been bought by New York capitalists for $150,000. The Carson - Hennessey - Walker properties, recently acquired by A. S. Stewart, have been sold by him to a London syndicate. The Freeland claim, adjoining one of the Armstrong-McGibbon groups, has been taken over by Charles Taylor, president of the Porcupine Gold Syndicating Co., New York, who recently visited Porcupine. Mr. Taylor and his associates, Robert Novrington, A. H. Crampton, and W. F. Bond, are prominent Nevada operators. John P. Hefferman of Montreal, vice-president of the Crown Chartered Co., has assumed active control of that property and a large force of men will be put to work. Under the direction of H. H. Webb, consulting engineer for the Consolidated Gold Fields of South Africa, active development has been started at the Rea mines, otherwise known as the Connell Veteran claims. On the main vein, which has been traced for several hundred feet, shafts are down to about 30 ft., showing good ore at that depth. The deepest workings are at the Timmins, where three shafts are down to a depth of 110 ft., at which there is a showing of free gold. Five shafts are in operation at the Dome and high-grade ore is being blocked out at 70 ft. At the Porcupine Gold Ridge sinking has been temporarily suspended at 50 ft. owing to flooding. A plant has been ordered.



A Typical Outcrop at Porcupine.

Cobalt.—Shipments have been well maintained, the consignments of ore and concentrate for October being 2807 tons, as compared with 2181 for September and 3099 for August. The total shipments for the first 10 months of the year were 26,008 tons, Kerr Lake leading with 665 tons, followed by Nipissing 623 tons, and La Rose 342 tons. There is a noticeable

scarcity of new producers, hardly enough making their appearance to replace those dropped from the list. Bullion shipments continue to increase, the total to date being 668,556 oz., of which the O'Brien contributed 288,406 oz. Though there has been nothing resembling a boom, the favourable reports from the leading mines, coupled with the appreciation in the price of silver, has found the market a little more responsive latterly, and both Kerr Lake and La Rose have scored considerable advances. The cheaper issues have generally been depressed, for the public is not in a speculative mood. The reported discovery of a new vein on the La Rose claim at the 170 ft. level has been fully confirmed and proves to be of great importance. This vein, which is parallel to the main vein, has been cut on the 62 and 157 ft. levels and opened up for 300 ft. It carries 4 to 5 inches of ore assaying about 4000 oz. per ton and its value is calculated at $2,500,000. The vein found in the Lawson on No. 8 vein at the 188 ft. level has continued to improve, yielding from 8 to 11 inches of high-grade ore. This discovery is regarded as of importance to the Hargrave property adjoining. The Temiskaming has issued a statement for the 9 months ending October 31, showing a profit of $579,364. The profit for the last quarter was $284,762. Some rich ore has been found at the 400 ft. level and as the formation remains unchanged in the lower workings equally favourable results at that depth are anticipated. At the Nipissing the vein known as No. 73 has shown almost continuous ore averaging 6 in. wide and carrying 2500 oz. silver per ton for a distance of 212 ft. A rise shows 10 inches of ore assaying 2000 oz. silver per ton. This vein is one of the most important on the property. The Beaver is working in rich ore 6 to 8 in. wide on the 250 ft. level, and on the 300 ft. level high-grade ore 40 ft. long has been found. At the Wetlauffer, in South Lorrain, a depth of 270 ft. has been reached and rich ore taken out. An addition of 20 stamps is being made to the Northern Customs concentrator, formerly known as the Muggsley, which will increase its capacity from 150 to 200 tons per day. The Townsite mine has contracted for the treatment of 50 tons daily.

Elk Lake and Gowganda districts are still badly handicapped owing to the lack of transport facilities, and there is a strong feeling of dissatisfaction with the Provincial Government for their remissness in railroad construction. The Lucky Godfrey at Elk Lake has closed down for lack of funds. The Montreal River Transportation Co., organized about three years ago to conduct a navigation service to and from these camps, has gone into liquidation, as the traffic was insufficient to support the enterprise. The Bartlett at Gowganda is being actively developed and taking out some good ore. The Boyd-Gordon in the same area has made an important find of high-grade ore in a contact vein between the conglomerate and diabase. Good reports are also received from the Reeve-Dobie.

General.—The St. Anthony gold mine, in the Sturgeon Lake district of northwestern Ontario, is in active operation, working in ore worth $60 per ton. Two drills are working double shift, and a 100-ton stamp mill costing $80,000 will be built in the spring.

Dr. Eugene Haanel, Canadian director of Mines, was in Winnipeg during the early part of the month making investigations with a view to the development of the extensive peat deposits near that city. The operation of the Government peat plant at Alfred, in the Ottawa district, having been successful in producing a cheap and satisfactory fuel, it is hoped that an impetus will be given to the peat industry in many localities in the West where coal has to be brought from a distance.

JOHANNESBURG.

Paved with Gold.—The old hands will tell you that in the pioneer days the Main Reef road to Fordsburg was metalled with 6 dwt. ore, or 'rock,' as it should have then been called. Such improvidence was worthy of the 'Golden City' in its palmy days, but the unsuccessful struggle of many mines at the present to maintain 6 dwt. screens proves that times have changed and a road of this value in the Germiston or Krugersdorp district would stand grave risk of being shifted in the night. However, the municipality is not reduced to totally barren rock. The accompanying photograph illustrates the crusher plant at the eastern shaft of the Robinson mine, whence a large quantity of road-metal and grit for cement is obtained for Johannesburg. It represents the waste from the sorting station and therefore, in this case, probably contains over half a pennyweight of gold per ton.

Metallurgical Progress.—The most noteworthy feature has been, of course, the introduction of the Butters vacuum-filter in the Crown Reef slime-plant. Soon, it is hoped, data will be available on the vital question of costs, all the critics being now assured that there is no defect in the efficiency. Other

metallurgical happenings, of which we hope to hear more later, are the experiments of E. H. Johnson at the East Rand Proprietary, where an abnormally high tube-mill ratio is enabling a duty of 25 tons per stamp per 24 hours to be attained. This fact again turns our thoughts to the perennial question, whether a more economical machine than the gravity stamp cannot be found for the comparatively low function of preparing a tube-mill feed. The only plates in a modern Rand mill are the shaking tables below the tube-mills. This is another item of plant in regard to which the Consolidated Gold Fields have been striving for improvement on drastic lines. Reliable tests, presumably under W. A. Caldecott's control, have been made with ordinary fixed plates below the tube-mills, with a length of 15 ft. and a grade of slightly over 2 in. per foot. Results are said to be wholly satisfactory, but here again we await the practical details.

Idle Mines.—The announcement of suspension of work at the Cloverfield, following close upon the news of the closing down of the Van Dyk, has had a depressing influence. The Neumann group has now seen the withdrawal of two of its properties from the active list, in the Vogel Deep and Cloverfield, but the Goerz group has hitherto carried its mines successfully through bad times, although the fate of the Roodepoort Central Deep, and perhaps the Lancaster, has been doubtful at some periods. Both the Cloverfield and Van Dyk have been decidedly disappointing in their development; otherwise, no doubt, money would now be provided for continued operation. In the Cloverfield, the ground so far disclosed has been distressfully low in grade and has lacked those rich zones, which are a marked feature of the Far East Rand. In the Van Dyk, the grade has been patchy and the formation seriously broken. Both mines will demand plucky handling for a successful revival. Though by no means condemned, they now lack the 'goodwill' of a going concern. The influence of their experience can be readily over-estimated in a re-consideration of East Rand prospects. Areas are so great in this district, that the Cloverfield disappointment can have no substantial influence on the Modder 'B,' Modderfontein, Brakpan, Springs, Van Ryn Deep, or Apex group, and although discouraging to the holders of the outlying regions, it will not be allowed to check the exploitation of Geduld, Grootvlei, Welgedacht, and Daggafontein.

Unification of Societies.—The political unification of the four South African colonies has been followed by an administrative unification—born of little less strife—in engineering circles. After months, and even years of hard work, checked in its effectiveness by a lamentable amount of petty rivalry and ill-feeling, the amalgamation of the Transvaal Institute of Mechanical Engineers and the South African Association of Engineers has at last been effected. It is now needless to elaborate the difficulties that have appeared in the way of this obviously desirable re-organization. The less said of them the better. Suffice it to express the hope that there is now an end to all the bickerings and that the new 'South African Institute of Engineers' is worthy of the profession. There is only scope for one such association in the Transvaal,

Utilization of waste rock from the Robinson gold mine.

where the busy men rarely find time for preparing papers and discussions. One body, however, will be representative and should be amply supplied with papers. It has been observable on several occasions during the last two years that it has been hard to provide the monthly meetings with contributions of a high standard, with the inevitable result that the reputation of both the old societies has suffered.

Rooiberg Tin.—This tin mine is one of the small producers, which, like the Zaaiplaats and Doornhoek properties, continues to record a steady yield. During the last financial year, it milled 15,713 tons containing an average of 4·88% metallic tin, resulting in the production of 696 short tons of marketable concentrate, assaying 68% metallic tin. This mine, working several fissures in the quartzite west of Warmbaths, is one of the few of its class attempting a definite ore reserve—the figure being

about 24,000 tons. There is a 10-stamp mill, serving Hartz jigs, Wilfley tables, and Frue vanners. Fine grinding is done by a Holman re-grinding pan.

Explosives. — A sub-committee of the Chemical, Metallurgical and Mining Society has drawn up some sound elementary instructions regarding the handling of explosives, which will probably have to be known as thoroughly by aspirants for blasting certificates as the Mining Regulations are by candidates for Government certificates of competency. It is to be hoped that these unofficial regulations will be followed more conscientiously by the users of explosives than does the Society follow its own regulations as to the use of technical terms. It is urged that when an efficient fuse-lighter is available "the *cheesa stick* make of blasting gelatine should be prohibited." Only a few weeks before, this term was denounced by the Society's standardization sub-committee as barbaric and unfit even for local employment in technical writing. To be quite just, however, it must be acknowledged that the use of the term "cheesa stick" in regulations for Rand application is unimpeachable. The instructions are issued for the benefit of Rand miners. Ambiguity must be prevented at all cost. It is therefore justifiable to use this pure Zulu word in sternest official documents, provided it makes for greater lucidity among those for whose guidance and safety it is intended.

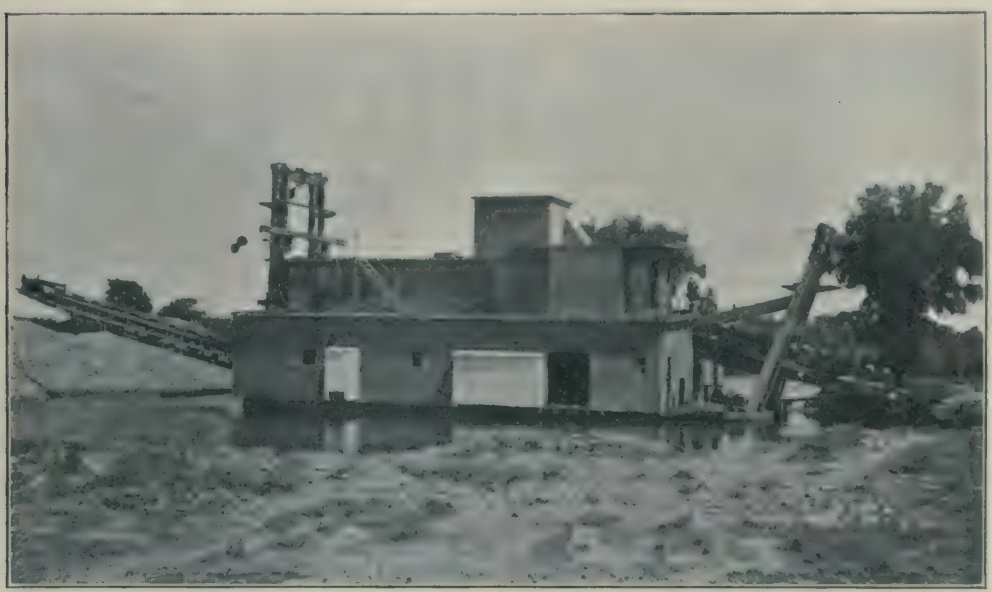
The Black Machine.—The good intentions so long expressed with regard to the closer care for the economic needs of the Kafir have been followed on many mines by tangible results. Beyond question, the proper care of feeding the Rand's most valuable power-generating machine has been badly neglected by many managements, and the inadequate provision of good food at critical times (as before going on shift) and of shelter in cold or wet weather at the shaft-head, has needlessly cost the industry thousands of pounds. The opinion has been expressed by J. A. Vaughan, President of the S.A. Association of Engineers, that the medical officers on the mines should take a far more active part in controlling the hygienic conditions and should attend as closely to measures for preventing sickness as for curing it. P. Snowden, a specialist on these matters (from the academic as well as the commercial standpoint) has publicly deplored the lack of interest shown by managers in questions of 'compound' management in its broadest aspect. The case can be easily over-stated; on the other hand, it may be fairly said that with a well-filled, healthy, contented, and efficient compound, one-third of a manager's troubles are dispelled. Some of the mines nowadays —notably the Crown Mines, Rose Deep, City Deep, and Witwatersrand Deep — provide covered ways from compound to shaft, shelters and 'soup kitchens' (where soup, cocoa, or coffee is given to 'boys' before and after shift) at the shaft-head, and enable or even force 'boys' to take that vitally important preventive measure against pneumonia, a warm shower-bath, before putting on their 'compound' clothing. In matters of this sort, the mine manager, guided by the medical officer, must lay down laws and see them enforced. The Kafir is incompetent to look after himself under strange conditions.

SAN FRANCISCO.

Oil Markets. — Undoubtedly the recent event of greatest importance to the mineral industry of the Pacific coast was the signing of a contract between the Associated Oil Co. and the Union-Producers Agency. Up to April there was no serious over-production of petroleum in California. In that month, however, the first of the great gushers of the Midway-Sunset field 'came in' and since June that district has produced more petroleum each month than in the whole preceding year. Naturally, transport facilities proved inadequate and the market was unable to absorb the oil as fast as it was produced. Prices fell until they were below the point at which any profit was possible. This is figured at 65 cents gross per barrel at the well, or 50c. net. In the meantime, the Union Oil Co., through its alliance with the Producers' Agency, controlled the bulk of the uncontracted fuel-oil. At the same time, the Associated found itself with more contracts than it was able to fill and a combination being so plainly to the mutual advantage of both, it was quickly arranged. According to the terms of the contract the Associated buys outright 5000 bbl. per day from the Union-Producers; in addition it undertakes to sell oil for the latter on a 10% commission basis and to turn over enough contracts so that the business shall be divided equally. The Union-Producers' concern has the option of ratifying contracts so transferred. Following the announcement of this arrangement the price of fuel-oil at points on San Francisco Bay rose at once to 80c. per bbl., from the 60 to 75c. at which it had been held by the Standard Oil Co. It is expected that it will go still higher and in the meantime

money is loaned on oil in storage on terms equivalent to a minimum of 35c. net at the well. It is estimated that the output for 1910 will approximate 75,000,000 barrels.

Oil Lands.—The situation as regards title to claims on the public land is still unsettled. The district was visited recently by Frank Pierce, Assistant Secretary of the Interior, who had numerous conferences with the oil operators. The situation was explained to him in detail and there are strong hopes that he will find a way to modify the rulings of the Department so as to carry out the apparent intent of the law to confirm the holding of those who had located claims prior to executive withdrawal of the land, and had proceeded in good faith to develop their claims. The matter is being further presented at Washington by a committee of oil producers and in the meantime the field has been visited by George Otis Smith, Director of the Geological Survey, a branch of the public service intimately concerned in the matter. In a general way the oil-men contend that in deciding questions of law the Department officials should adopt the interpretation of the local courts. If this be done, the oil-men can proceed in the light of past custom. This would, however, be equivalent to surrender on the part of high Federal officials of their acknowledged discretion. The subordinate courts, while well-informed, are held to be influenced frequently by local public opinion and as a rule the higher courts have hesitated to interfere with Department officials in their findings. At present, there is no legal means, for example, of compelling the Land Office to issue a patent to ground, its decision as to the validity of a claim being final. R. A. Ballinger, the present Secretary, has recommended as one means of ending the controversy regarding the Alaska coal-lands, that the findings of the Department be subject to review by the Federal Court of the District of Columbia. This is not a new suggestion, and has been opposed by Western mining men who while willing enough to have the right of appeal to a Court, wish to have all District Courts given jurisdiction. This would have the effect of bringing the cases before judges living in the States concerned and therefore well-informed as to local practices—and public opinion. In the East it is feared that the latter may be at the same time unsound and too influential. There is also a feeling that it is undignified to have the findings of a Secretary subject to review as to both facts and law by any Court, and this has hitherto prevented Congress from accepting the Western point of view.



DREDGE AT SNELLING, CALIFORNIA.

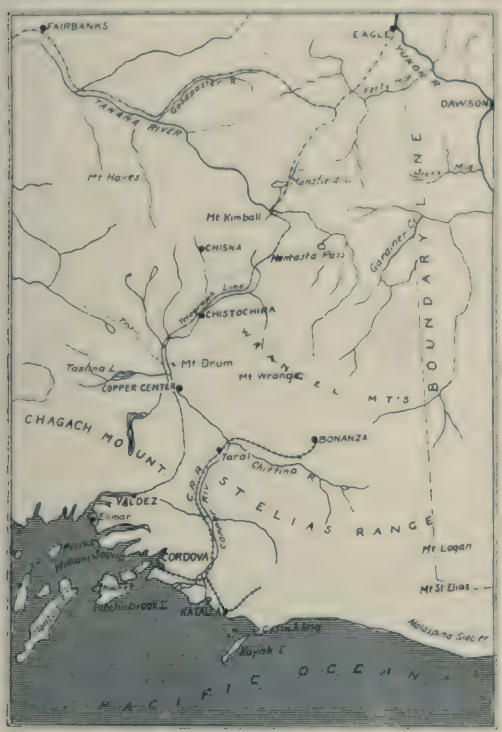
Gold Dredging.—The California State Mining Bureau, a moribund branch of the State Government that has long been practically useless because of the blight of corrupt politics, has at last an excellent report to its credit. As a matter of fact, the credit should go not to the Bureau or its head, but to two

engineers, W. B. Winston and Charles Janin, who prepared the report largely because of their professional interest. One received no compensation and the other but a nominal sum. Their associates in the profession are greatly indebted to them for their good work. The report discusses gold dredging in California and covers the technology and statistics of the industry. Geology is treated only briefly. It is estimated, on the basis of returns made to the U.S. Geological Survey that the total return from California dredges, to the close of 1908, was $25,277,877. Since the total investment, aside from land, has been approximately $8,995,000, the average yield per cubic yard 12 to 15 cents, and the cost of operation 4 to 7 cents, it is clear that the industry is unusually profitable. In addition to direct returns, it has proved possible in certain cases to add largely to the income by sale of crushed rock, and in the end much of the dredged land can be reclaimed and sold for agricultural purposes. At present the proved dredgeable ground consists of 19,200 acres scattered through 9 counties. Much additional territory has never been adequately prospected, but opinion among engineers is to the effect that it will not be easy to add greatly to the reserves in California. In the absence of a thorough geological survey it is impossible to determine this matter.

Alaska returns are not yet all in, though the last boat has come down from the Seward peninsula. Nome had a quiet season, with steady work, and has sent out about $3,400,000 worth of gold. The stampede to the Iditarod region has not yielded large results, as most of the 'stampeders' took one look at the country and returned. A few determined prospectors scattered over the country and may yet report finds of importance. Fairbanks has been busier than Nome and has done better. It is still an open question whether the placers will pay for re-working and the virgin ground is rapidly decreasing. An interesting feature of the year has been the extensive development of quartz veins. While nothing enormous has yet developed, a number of excellent prospects have been opened and over $40,000 has been cleaned up in the small testing mill built last winter. At Dawson, quartz mining has not resulted so favourably. The cross-cuts driven to cut the veins at depth either failed to find them or crossed the veins at points where they were small and barren. The feeling now is that for large quartz mines the prospectors must go to the main mountain range, which lies back from the river at a discouraging distance. The hydraulic mines have done well, though the season is short. The dredges have done exceptionally well, having shown their ability to handle the ground rapidly and economically. It is expected that the report of the Yukon Gold Co. for this year will be encouraging. The Bear Creek dredge has had an excellent season. In working the ground the brush and roots cleared in the summer are stacked at convenient points and used to generate steam in the winter for keeping open the pond and thawing the ground. In this way the length of the season is limited only by the amount of fuel available. The new dredge is being assembled. It is to have buckets of 15 cu. ft. capacity, each weighing over two tons. The total weight of the dredge will be approximately 900 tons and the transportation of the heavy pieces has involved some difficulty even over the good roads of the Klondyke district. On the Coast the season has been one of quiet, steady work. Rapid progress is being made in equipping the mill of the Ebner gold mine, which is expected to become a great low-grade property comparable to those that already characterize the district about Juneau. The California-Nevada Copper Co., the owners, have just purchased the entire capital stock of the Humboldt Gold Mining Co. owning 32 acres on both sides of Gold creek, and a 5-stamp mill. The chief importance of the deal lies in the fact that it gives the California-Nevada company complete control of the water-power of Gold creek and will permit development of 3000 horsepower. In the Cook Inlet and Prince William Sound regions matters have been at a standstill this season owing to the difficulty over coal lands. Good progress has been made, however, in building the Copper River & Northwestern railroad, and there has been such complete discussion of Alaskan affairs that there are strong hopes of remedial legislation being enacted this winter.

Company Reports.—Among reports just at hand are those of the Federal Mining & Smelting Co., operating lead mines in the Cœur d'Alene district and the Montana-Tonopah, of Tonopah, Nevada. The first will be remembered as one of the great lead-producers, long rated as a Guggenheim concern and lately engaged in litigation with its neighbour, the Bunker Hill & Sullivan. The Federal has not previously presented reports characterized by much detail and while the present is delightfully frank in discussion of ore reserves and metallurgical problems, nothing relating to costs is given. The total produc-

tion for the year ended August 31 amounted to $4,757,468, on which there was a profit of $745,053. Other sources of income raised this to $830,201, but it was still necessary to draw slightly on the surplus to pay dividends, amounting to $839,027, on the preferred stock. Nevertheless, the present surplus is $1,015,109. In the Wardner mines the ore reserves is 313,600 tons, about equal to two years' supply, having increased 41,080 tons in the year. At Mace the reserve is 234,675 tons, about



Part of Alaska.

equal to one year's supply. It decreased 33,305 tons during the year. In the great and long-profitable Morning mine the reserve was drawn on heavily but still stands at the respectable figure of 543,000 tons. As this ore contains 7 to 8% lead it would be of large value except that its character is such that a saving of only 60% can be made in the mills in place of the 80% that was formerly obtained. W. Clayton Miller, the general manager, states that experiments are being made with Macquisten tubes and other devices in hope of bettering the saving. If, however, this cannot be effected, he recommends that the Morning be closed rather than dissipate the reserves. Since under the terms of the settlement with the Bunker Hill & Sullivan the life of the Wardner mines is limited, that would leave the company dependent on the Mace. Fortunately there is undeveloped ground still available and there are important holdings in other companies. Mr. Miller recommends an active campaign of development and purchase, and a company with two years' ore reserves, a million dollars in cash, and an active and capable manager is far from being a negligible quantity however the stock may be regarded in the market.

The Montana-Tonopah, under the excellent management of Edgar A. Collins, continues to pull ahead, despite many difficulties. It will be recalled that this company had to sink several hundred feet through overlying lava before entering ore-bearing ground, and had then to find its ore in a much faulted complex of igneous veins. The veins are small but rich, the average of the 50,245 tons milled being $15·22, made up of 0·206 oz. gold at $20 per oz., and 21·139 oz. silver at $0·5253. The ore is treated by cyanidation at a cost, exclusive of depreciation, of $3·734 per ton, and with a saving of 90·8%, the tailing assaying $1·43. During the year the saving in the mill was slightly increased, but this was offset by decrease in the size of the veins. The total cost of mining was $3·397 per ton, to which should be added $1·836 for development. To secure the 50,245 tons of ore hoisted it was necessary to hoist 19,003 tons of waste, though much is used to fill stopes. Owing to the greatly faulted condition of the orebodies it is difficult to outline them without doing unnecessary work. Accordingly, no large reserve of ore is carried. At the date of the report, August 31, the probable ore available in the mine was estimated by Mr. Collins at 26,000 tons. While no dividends were paid, the cash balance was increased $128,208·47 during the year.

CAMBORNE.

Dolcoath.—It is cheering to record that the profit for the current six months has been so satisfactory as to warrant the distribution of a dividend of 9d. per share on account of the current half-year. According to the published returns for the 20 weeks ended November 12, 34,892 tons of ore has been crushed and 672 tons of black tin sold, realizing £63,218. The average price per ton was £94. 1s. 6d. or roughly 10d. per lb. The average recovery has been 43 lbs. per ton, 2·60 lb. above that of the previous six months; on the tonnage named and with black tin fetching 10d. per lb., this means an increased money value for the period of £3800. The average price for the first 20

weeks of the previous six months was £88. 8s., while as already mentioned the average is now £94. 1s. 6d.; that is an advance of £5. 13. 6d. per ton, which gives a further increase in revenue of approximately £3800. For the first 20 weeks of the current six months the receipts have therefore increased by about £7600. If this ratio continues, and the working costs have not increased, then the profit for the half-year should be better than the previous one by nearly £10,000 and will be the most satisfactory since 1907.

Parbola Mine.—Operations on this property at Gwinear have been totally suspended, and unless further capital is raised the valuable plant erected during the past three years will be dismantled. According to the statement of the late manager the sum expended on developments, buildings, and plant, was no less than £35,000. It will be a great pity if a 'bal' with the possibilities of Parbola should not be given another lease of life under scientific direction. For anyone liking a low-grade proposition, the great elvan course running through this property would give ample scope.

East Pool & Agar.—It is regrettable that the past quarter's working has resulted in a loss of £702. It was generally anticipated that the discovery made in Wheal Agar, referred to in a previous letter, would enable the management to increase the grade of ore treated sufficiently to meet current costs, and to provide a little more for increased developments and repairs to the shafts. However, it is stated that this discovery is inaccessible until the pitwork in Wheal Agar shaft has been put in thorough repair. One of the reasons given for the loss on the past quarter's work is the expense entailed in this direction. Another reason is the decrease of 1600 in the tonnage crushed, owing to deficiency of water for dressing purposes and to the rising of the sand in the Red River, with subsequent floods which submerged the slime-plant and other parts of the dressing-floors. Development is still on a restricted scale and it is a great pity that a big effort is not made to convert the company into one of limited liability, and to endeavour to induce capitalists to put up a good round sum to properly develop and equip the property. Present shareholders are apparently unwilling to do more than provide funds which just enable the management to live from hand to mouth, so doing the work in driblets, and at probably double the expense. The directors probably think that they have a good thing in the Great Lode at Wheal Agar, that in time will pull them through; but if the property is to be made into a steady dividend producer, all the profits made from the new discovery will for a long time to come have to be put back into the mine to provide for increased development. The time to try to interest outside capitalists is not when the 'bal' has been skinned and the company on its beam ends, but when there is something to show to encourage investment. The output for the past quarter was 14,756 tons, or 1614 tons less than during the previous 12 weeks, while the development was 293 ft., only one foot for every 50 tons of ore mined. The costs were £14,507, or 19s. 7d. per ton, and the receipts £13,805 or 18s. 8d. per ton, showing a loss of 11d. per ton of ore treated.

Hingston & Clitters.—After an existence of ten years, this company has decided to suspend operations and go into voluntary liquidation. Formed as the Clitters United Mines Ltd. towards the close of the year 1900 with a nominal capital of £160,000, the company first directed its attention to the development of the Clitters sett and to the treatment of dumps at Clitters and the Greenhill works, consisting chiefly of ore containing wolfram and cassiterite, which the previous workers had thrown away as valueless. The German engineers associated with the Clitters Co. introduced magnetic separation and by this means were able, until the dumps were exhausted, to show fair profits. However, the developments at Clitters proved disappointing and attention was turned to the Hingston sett. The expense involved in unwatering this mine, owing to the crookedness of the shaft, together with electric pumping troubles, swallowed up all the working capital. A new company named Hingston & Clitters United Mines Ltd. was registered in 1908 for the purpose of further exploring the orebodies, and £15,000 more capital subscribed. This company has met with no success, the reserves developed not being sufficient to keep up a regular output, and now the company is to liquidate. Those associated with this enterprise will always have to their credit the fact that they were the pioneers of magnetic separation for tin-wolfram ores in the West of England. Their process when first introduced was sneered at by Cornish engineers, as was the Wilfley table and other modern improvements; but it has since received due recognition and has proved of great value to several mines in West Cornwall.

Phœnix.—The crosscut at the 720 ft. level towards the old mine has been driven 168 ft. from the new (Prince of Wales) shaft, but the progress is not so good as formerly, as long bore-holes have to be drilled in advance of the

fore-breast now that the crosscut is approaching the water in the old workings. The installation of the western cage-road from surface to the 720 ft. level has recently been completed.

Carn Brea & Tincroft.—We understand that Mr. Basset has offered to contribute toward the cost of the development of the Macdonald's section of Carn Brea an amount equal to the dues accruing to him in the next two years, providing the company will spend an equal sum for the same purpose. This is a concession that will be appreciated by all interested in the mines, and coupled with Viscount Clifden's gift referred to in previous issues of the Magazine, shows that the 'lords' are not so bad as they have been painted by some of the principal shareholders, who should now feel encouraged to find further funds to vigorously develop the property on the lines laid down by R. A. Thomas in his recent report. The drifts east and west at the 96-fm. level at Macdonald's are being kept going day and night with a full complement of men, and in each the lode is strong-looking and wider than the level carried. The last 189 tons of lode-stuff from here, according to the report issued on November 25, averaged 31'4 lb. black tin per ton.

NEW YORK.

The election has come and gone, and Wall Street is happy. Happy, not only because the election is over, itself sufficient reason for rejoicing on the part of the earnest advocates of "let well enough alone" who inhabit the financial district of New York, but for the further reason that in the New York returns Mr. Roosevelt's candidate and party were hopelessly defeated. By his enemies this is heralded as a crushing reversal that will eliminate him from politics. By his friends it is looked on as an incidental setback discounted by the fact that prior to his entry into the campaign the election of the Democratic candidate was conceded. That there should have been any doubt at any time is a tribute to Mr. Roosevelt's power. In general the Democrats won throughout the country, though in most cases where the Republican candidates were progressives the latter held their own. The net effect is to give the Democrats control of the House and the Republicans of the Senate at Washington, thus effectually blocking any further legislation not of routine character, for two years. That is one reason for rejoicing on Wall Street. Recent years have been hard on divers and sundry gentlemen who had learned to play according to the rules of the game as understood prior to the insurance scandals. Since then there has been a flood of new legislation and whether it be because of exposure of corruption in high financial circles or because of too drastic legislation designed to correct abuses, the fact is that promotion of even worthy enterprises has been difficult. It is an open secret that the underwriting syndicates have had to absorb the greater part of even excellent bond issues. Houses that deal only in thoroughly good securities have entirely failed to distribute bonds that ordinarily would be regarded as gilt-edged. Underlying conditions none the less are, and

Anaconda, Montana.

have been, good. Crops are excellent and the current business of the country is large in volume. The difficulty is to get money for re-investment in betterments and extensions. There is an increasing surplus of idle capital, as shown by the growing savings-bank deposits. The farmers, too, are buying land in Canada and elsewhere, liberally, but there is little or no market for stocks or bonds, whether good or bad. Being firmly convinced that 'radical legislation' is the cause of this dullness of the market, moneyed men generally are pleased at the assured deadlock at Washington. Time alone will tell whether they have mistaken occasion for cause. In the meantime it may be pointed out that even excellent American corporations cannot raise money abroad on fair terms and have not been able to do so since the insurance scandals and the exposure of the methods adopted in refinancing the Chicago and Alton railroad.

Copper has risen a little in price and the surplus continues to decrease, though as yet

the effect of curtailment of production has not been shown in the figures of the Copper Producers Association. According to the statement made November 10 the production in October was 126,069,284 pounds, an increase of 6,549,391 over that for the preceding month. Domestic consumption amounted to 67,814,172 and exports to 68,186,910. The surplus at the end of the month was 139,261,914, as compared with 148,793,714 at the beginning. The most significant fact is that since February the foreign as well as American surplus has decreased so that there is now more nearly a parity between production and consumption than there has been for some time. Pending decision by the Supreme Court in the Standard Oil and American Tobacco Co. cases, it is not politic to discuss the possibility of a copper merger, but no one can read the history of the last half-year without concluding that there is an understanding between the leading copper producers. The purchase by J. P. Morgan of a substantial interest in the Cerro de Pasco, and the giving by the Lewisohns of smelting contracts to both the Guggenheims and the Phelps-Dodge interests, are facts of some significance. While, too, the Guggenheim and the Cole-Ryan smelting concerns are popularly supposed to be about to engage in a war to capture the copper-smelting industry, it is not to be forgotten that there are many connecting ties between the financial interests at the back of these groups. If the Court decides that the Standard Oil and American Tobacco companies are properly and legally organized concerns, no one doubts that a copper corporation modelled along the lines of the U.S. Steel Corporation will be at once formed. If the decision is adverse, there is still likely to be further consolidation by purchase.

Guggenheim Finance. — Of special interest to mining men is a recent report to the effect that the American Smelters Securities Co. is to issue $15,000,000 in 6% bonds, $10,000,000 of the proceeds to be used to repay loans from the American Smelting & Refining Co., and $5,000,000 to be retained as working capital. So far, this is not a bad move, since the chief weakness of the Securities company has been the absence of adequate working capital. However, it is further proposed that the money repaid to the A. S. & R., and which will constitute a large fraction of the surplus that has given value to that stock, shall be re-invested in the common stock of the Securities company, largely owned by the Guggenheims. This stock now has no value, but part of the 'working capital' supplied to the Securities company will be used to start payment of 4% dividends. The whole scheme as proposed would have the effect of neatly transferring to the public from the Guggenheims a load of stock that the present owners carry on their books at a value of $1 for the lot. It is but charitable to suppose that the plan announced is but a 'feeler.' The universal condemnation with which it has been met makes it improbable that it will be carried out, but that it should have been proposed is significant of the conditions under which capital for mining enterprises is being asked in America.

Spelter continues to rise, being quoted just below 6c. per pound at New York, November 9. No great sales are being made at this price and the belief is general that it is artificial. At the same time, it is clear that high prices will prevail this winter. The tariff on zinc ore and the shortage of natural gas in Kansas are responsible. The plants at Iola, in the latter State, have been closed, and owing to the difficulty of finding money for new enterprises, coal-fired plants have not been built in the Middle West in anticipation of the gas shortage, as explained by R. G. Hall in the *Mining and Scientific Press* some months ago. It is possible that this winter some of the old hand-fired coal furnaces may be again put into commission. It is now estimated that 'Prime Western' spelter is being produced at the rate of 200,000 to 225,000 tons per annum, which is below normal, despite good demand. One result of this condition has been greatly to stimulate zinc mining, not only at Joplin, but in Western and Southern districts which have been neglected of recent years. New Yorkers have become interested in the development of the low-grade deposits of zinc ore that occur through an extensive area in eastern Tennessee and southwestern Virginia. These deposits have long been known and have been worked previously. At one time Indiana furnaces drew heavily on these deposits. The Bertha furnace, at Pulaski, Virginia, was built to treat the ore of this district and established an enviable reputation for the high grade of its spelter. For some years the demand for metal has been greater than could be met from local ores and a large part of the furnace charge has consisted of willemite from New Jersey. This has been supplemented by local ore and flue-dust from the iron furnaces of the Shenandoah valley, where zinc is commonly associated with the iron ore. A unique and excellent practice has been developed as a result of the necessities of the situation, and great credit is due J. A. Van Mater and his

associates. Since 1900 shipments from this region have been small. Last year the Grasselli Chemical company entered the field and it is now shipping carbonate ore from the Newmarket mine, using steam-shovels and working in open pits. The Osgood Exploration Co., the Roseberry Zinc Co., and the Tennessee Mineral Co., have followed suit. With commendable enterprise, the new State geologist of Tennessee, George H. Ashley, has issued a report on the deposits. The ore occurs in a Cambro-Ordovician dolomite and the bodies are large. While low-grade they are capable of producing an exceptionally clean concentrate. The clean carbonate originally present has been largely mined, and from now on mixed carbonate and blende ores must be handled. The ground is being prospected by drilling from the surface as at Joplin, and the ore will be treated by concentration. In practice four tons of concentrate assaying 60% zinc are won from milling 100 tons of ore. Geologists familiar with the field have faith in the extent of the deposits, and it is intimated that large-scale mining will do for the zinc industry of the region what it has already done for copper at Ducktown. Incidentally there is a possibility of more extensive local smelting because of cheap fuel and labour, and a demand for sulphuric acid in the fertilizer industry of the Southern States.

BEGINNING TO EXCAVATE FOR THE FOUNDATIONS OF THE NEW SANTA GERTRUDIS MILL (now almost completed) at Pachuca.

Metal prices have shown a disposition to improve lately with the exception of lead. That remains steady at about 4·40 c., though the demand is good. The price of tin has been erratic owing to temporary shortage of ore. That was relieved early in November when the steamer *Minneapolis* arrived with a cargo from the Straits Settlements. The prevailing higher price for silver has greatly stimulated Western metal mining, while in the East steel and iron sales are good. Copper is sold up to the first of the year.

MEXICO.

Recent Disturbances. — That Mexico will suffer to some extent as a result of the recent anti-American riots and revolutionary disturbances is to be expected. Capital, always timid, is halting to await developments. However, the Diaz government has again given evidence of its strength, and if there is no early recurrence of disorder, this country of many opportunities will undoubtedly regain full favour with foreign investors. To foreigners who have resided for years in Mexico, and who have seen the lives and property of foreign residents zealously guarded, the most surprising feature of the anti-American outbreak was the laxity shown by the authorities at the start in dealing with the rioters. Henry Lane Wilson, the American ambassador, declared that the police authorities of Mexico City showed themselves "wan-

tonly neglectful of their duties, standing idly by while the American flag was outraged and American persons and property were attacked." In Guadalajara it was not until after an American resident, in defending his home and family against the attack of a mob, killed one of the rioters and wounded a policeman, that the authorities were roused to energetic action. In Mexico many rumours are now rife. One is that Vice-President Corral, who is ill, will resign the vice-presidency and go to Europe for his health; that Finance Minister Limantour will retire from the Cabinet, and that General Bernardo Reyes, now in Europe on a Government commission, will be recalled to succeed Corral as vice-president. For years bitter enmity has existed between Limantour and Reyes, and the recall of the latter would be possible only in the event of the former's retirement. There are many in Mexico who regard Reyes as the strongest man after Diaz. Another rumour is that Henry Clay Creel, Minister for Foreign Affairs, will succeed to the vice-presidency. It is felt in some official circles that the fact that Creel is the son of an American might mean a troubled administration in the event of his succession to the presidency. Diaz is now over 80 years of age, and it is feared that he will not be able to continue actively in charge of executive affairs until the end of the six-year term on which he has just entered.

Coahuila Coal and Coke. — A statement covering the production of the several companies operating in the coalfields of Coahuila during the first nine months of this year shows the growing importance of the coal and coke industry in that State. The totals are 1,213,163 tons of coal and 165,653 tons of coke. The Mexican Coal & Coke Co., also operating the mines of the Coahuila Coal Co. and the Fuente Coal Co., leads in coal production, the output for the nine months being 474,804 tons, with 36,029 tons of coke. The Compañia Carbonifera de Agujita and the Compañia Carbonifera de Lampacitos, controlled by the same interests, produced a total of 102,948 tons of coke and 255,177 tons of coal. The only other coke-producing concern is the New Sabinas Co., which had an output of 26,676 tons, and 71,623 tons of coal. The other Coahuila coal companies produced as follows: Compañia Carbonifera del Norte, 74,044 tons; Compañia C. de Ciudad Porfirio Diaz, 59,269; Compañia C. de Sabinas, 210,837; Compañia C. de Rio Escondido, 63,609; Compañia C. El Fenix, 3791. A year ago the National Railways of Mexico (the Government system) placed in effect a differential rate in favour of Coahuila coal and coke as against the imported products, and this has helped the industry considerably. Coahuila is at present the only Mexican State producing commercial coal and coke. Development work isin progress at coalfields in Sonora and Oaxaca.

Mazatlan.—The State concession for a custom smelter at the Pacific port of Mazatlan, granted several years ago to A. H. McKay, then closely identified with Southern Pacific interests in Mexico, has been purchased by the Pacific Smelting & Mining Co., the New York concern owning the smelting plants at Fundicion and Guaymas, in Sonora. It is stated that the smelter will be built as soon as there is assurance of steady ore supplies. The concession provides for important tax exemptions. With smelters at Guaymas, Fundicion, and Mazatlan the company expects to have an important part in the development of the mineral districts of the West Coast, and to build up a big custom business. It was recently reported that the Guggenheims were considering the purchase of the Mazatlan concession and the erection of a smelter at that port. Good progress has been made in arranging contracts for ore for the Fundicion and Guaymas plants, and it is expected to have both in operation by March of next year.

San Carlos. — Shipments of bullion are being made from the plant of the San Carlos Gold Mines, in the Mezquital del Oro district of Zacatecas, to the Guadalajara branch of the Bank of London & Mexico. At present the output is from 50,000 to 60,000 pesos monthly. The Mezquital and San Carlos gold mines have been owned by English interests for a number of years, and several re-organizations have taken place. Capital for present operations was obtained last year. The company has a 50-stamp mill, amalgamating plates, and cyanide plant. English foremen are in charge of all departments.

Matehuala.—The capacity of the Matehuala smelting plant, purchased early this year from the National Metallurgical Co. by the American Smelters' Securities Co. (Guggenheims) is being increased to 800 tons daily by the erection of a 500-ton furnace. The new furnace will be in operation early in the coming year. The big Dolores mine in the Matehuala district has been controlled by the Guggenheims for a number of years, and several important properties were acquired with the smelter from the National Metallurgical Co.

Magistral - Ameca. — French interests identified with several mining enterprises in Mexico have taken a block of the stock of the Magistral-Ameca Mining Co., of Los Angeles, owning the Magistral copper mine and concentrating plant in the Ameca district of Jalisco. The purchase will provide a fund of 200,000 pesos after the payment of all indebtedness, and this money will be used in pushing development and enlarging the reduction plant. Additional equipment that will give the plant a concentrating capacity of 150 tons daily will be installed. Percy A. Babb, a Mexico City mining engineer, brought about the investment.

The Rurales on Parade.

San Antonio. — This copper company, controlled by the Cole-Ryan interests, is opening a property of great importance at San Antonio de la Huerta, in the Ures district of Sonora. The development has been principally by adits, 19 having been driven, the work to date aggregating 30,000 ft. Surveys for an adit 4500 ft. long to cut the vein 1200 ft. below the outcrop have been made, and work will be started soon. The company will later build a smelter near the property.

LIMA.

Cerro de Pasco.—The largest production as yet made by the Cerro de Pasco smelter was in October, resulting in 4,926,000 pounds of copper. The anticipated curtailment of operations, due to the coal-mine disaster in August, was fortunately not required, so that the shipment of copper cakes was not interrupted and therefore no matte was sent to the United States. Experiments in the converting plant are contemplated; a basic lining will be tried. After several years of discussion it has finally been decided that a new townsite for Cerro de Pasco be selected, the choice having been made in the vicinity of Lake Quilacocha, a few kilometres to the southwest of the present settlement. No doubt plans will be made to lay out a well arranged and healthy town, much superior to the old town which, aside from being in a dangerous condition (owing to the continual caving of the *antigua* workings, near the surface and under the houses), is a hotbed of typhoid and other diseases. No one who has visited there in the rainy season can forget the mud and filth. The Cerro de Pasco's plant will not suffer disturbance, as it has been so arranged as to lie on the outskirts of the old site.

Ferrobamba.—The news of the passing of the control of the Ferrobamba properties to American capital came as a surprise to local people, who felt that, if the proposition was so large, English capital should have had the opportunity of making it a serious factor in the copper world. Evidently America will continue to control the copper market.

A party of American engineers is examining the Santa Inez and Huachocolpa regions—near Huancarelica—which appear to be interesting mineralized zones; transportation is somewhat of a drawback.

The Sayapullo district was again recently visited by an American engineer; a 30-ton water-jacketed furnace is nearly ready to be 'blown in,' the results of which will be interesting apart from the attempt to utilize anthracite coal instead of coke. French engineers have been examining the copper veins

of Huaillay—about 35 miles southwest from Cerro de Pasco—for several weeks. The mines are situated at an elevation of over 15,000 ft. above sea-level; a sad incident occurred a few days ago, when one of the French assistants died as the result of *seroche* (mountain sickness). To one unfamiliar with such altitudes and the kind of food available, especial precautions are absolutely necessary. It is stated that a railroad will be built to connect the properties with the Central Railroad of Peru, at Casapalca, which would effect a shorter haul to the coast than tapping the Cerro de Pasco line at Unish. This region has been exploited for some years and ore averaging 24% copper, and better, was shipped. The attempt to smelt the low-grade ores, in a 30-ton furnace with local coal, was not a success, probably due more to lack of experience than to other conditions.

MELBOURNE.

Gold stealing is sadly prevalent in Victoria especially in alluvial mines where the precious metal occurs in nugget form. The Cathcart at Ararat is a claim that furnishes the miner with many temptations. Not a week elapses but nuggets ranging up to 15 oz. are found in the 'gutter.' The consequence is that special shift-bosses and three detectives are constantly on the alert to stop pilfering. The extent to which the evil exists has just been disclosed during the hearing of a case in which it was shown that unlicensed gold buyers had fallen out. The one entrusted with the sale of a large parcel of gold declined to give up the proceeds; then ensued washing of dirty linen and hard swearing much to the edification of the public. This revelation has happened most opportunely, when the Labour party of the State Parliament wanted to obtain some modification of the law in respect to gold stealing. The members of the Party have not believed that the evil was as great as alleged, and have sympathized with the miners as a class that had been singled out for specially repressive legislation. But they will find it hard to get past the facts that have come to light. The usual procedure is for the buyers to work some small claim and then allege that the gold came from it.

The Great Fitzroy meeting was a tame affair. No one came to ask awkward questions, whereupon the chairman had nothing to do save to make the usual set speech. But this contained a frank statement of disappointment. Praise was bestowed upon Mr. W. J. Loring for the way in which he had gone into matters in his special report. It was pointed out that he had not been hindered by the fact that the mine had been under the control of his firm all along. After all, while it is very nice for directors to say these sort of things, Mr. Loring had to do his duty. If he found that the work was defective or that the mine was not up to expectations, he, as a mining engineer, could not shut his eyes to the facts. The truth had to be stated whether his firm was in control or not. That he did hit out pretty straight is shown by the following extract from his special report. It explains everything and therefore should be given:

"The cause of the present trouble can be summed up by stating that the late superintendent was over-sanguine of his ability to do more than anyone had ever accomplished before on an ore of the character of the Fitzroy. As an old and trusted employee of the General Managers, and one in whom you all had the greatest confidence, complete checks on his work were not made. In justice to all concerned, however, I wish to say that no great harm has been done, as the plant, aside from the mill, is well-constructed, and will render a good account of itself. Some time has been lost in testing the suitability or otherwise of the concentrating plant, but a large proportion of the present mill will still be used in connection with the flotation plant now under construction. It would require the remainder of 1910 to finish the work now in hand, and I would not advise any rush-work, as it would be both expensive and unsatisfactory."

Broken Hill.—At last the plan of the Broken Hill Junction North boring is available to show how an orebody 100 ft. wide may cut out in 200 ft. of vertical depth although showing the greatest strength at the bottom of the level. It looks as if there had been a big fold of horse-shoe shape with the wide part of the shoe lying downward to the west. The plans indicate beyond all doubt that the company has lost a shoot of ore nearly 600 ft. in length and averaging nearly 100 ft. in width. The North Broken Hill officials are still satisfied that the course of the ore in their ground will not be affected although the orebody pitches into their claim. Their contention is that the ore-shoot is only resuming its normal pitch after having gone down so much more vertically in the upper levels than was ever expected. But the country at 1300 ft. is much tighter than higher up and as there have been one or two similar experiences of the cutting out of ore at the Barrier, notably the big bulge in the Block 10, it is wise that those who

believe in the north end of the field should not altogether lose sight of developments in the central and southern parts. The net result of the work done at the Junction North for the half-year was, if depreciation be allowed, a slight loss to the company. The ore in sight is about 325,000 tons.

John Warren.—The death is recorded of John Warren, formerly the general manager of the Broken Hill Block 10 Company, and one of the pioneers of the Barrier. Cap'n John, as he was affectionately called by those who knew him, had a mining experience that falls to the lot of a few. He started his career at Wallaroo, South Australia, where he managed the Hamley, among other mines; he then went to the Balade copper mine in New Caledonia, returned to Australia to take charge of the Bird-in-Hand gold mine near Adelaide and then went to the Barrier, where he remained until quite recently. His chief exploit at the Barrier was the pioneer work in the treatment of sulphide ores. T. J. Greenway, of the British and South mines, and John Warren were the leaders in experimenting with water-concentration and to them belongs the credit of giving Broken Hill its second lease of life, just as Potter was instrumental in giving it a third, no matter what claims other people may make. John Warren was a man of the highest probity, beloved by his staff, admired and respected by his employers, and trusted everywhere. Such as he constitute the salt of the earth.

Bendigo.—While exciting events have drawn attention to Western Australia, other Australian mining interests have been largely obscured. It is gratifying to Victorians to find that their old favourite, the Bendigo goldfield, is looking better than it has done for some time past. The developments on the side lines, especially the Sheepshead, are most satisfactory and it is certain that had the Bullfinch rush not occurred there would have been a considerable influx of capital to that centre. But the rush after new finds may check such a move. On the Sheepshead line ore averaging over 2 oz. per ton is being steadily mined at the Central Red White & Blue. The formation is not large but that such returns should come from a neglected 'formation' means a lot. Then Johnson's Reef on the Garden Gully, one of the main lines, which have been worked for nearly half a century, is looking up again. Some of the other big mines also are improving their position, especially the South New Moon, which for several years paid splendid dividends.

Cathcart.—More surprising was the Cathcart alluvial revival at Ararat. This is the mine formerly held by Bewick, Moreing & Co. For some time it was under a cloud but lately the lead on the rising ground has proved productive and the supporters of the mine do not hesitate to declare that the outlook is better than at the time of the ill-fated boom. For the sake of alluvial mining it is to be hoped that such is the case, because anything of the kind would mean that there would be no doubt as to capital being forthcoming for the development of the great Langi Lagan system, to which the Cathcart is a tributary. This 'gutter' is absolutely undeveloped but it has been 'shepherded' for 25 years. Capital is now being invested in sinking and driving to explore the ground.

Tasmania.—The boom at Mt. Balfour has simmered down to the most modest dimensions, only a few claims being left to prove whether copper lives down in a highly silicious formation. On that point a doubt has been expressed persistently in these columns and unfortunately so far nothing has occurred to shake my opinions on the subject. The Tasmania gold mine development at depth apparently has not been so extensive as was hoped. Shareholders on this side wanted the board to abandon its intention to reconstruct the company and provide fresh capital. Fortunately the London board were adamant. The assays obtained at the bottom level were encouraging but the ore actually proved was insufficient to demonstrate that the poor zone had been altogether left. At the Mt. Lyell the bottom level is certainly not up to the 1000 ft. in point of yield and is less favourable than developments at 850 ft. The company is pushing on with its super-phosphate works and has just opened a plant at Perth at a cost of about £70,000. It has now spent £250,000 on this branch of its enterprise without calling up capital in any way. So it can be said that the management does well for the shareholders. Tin mining is quiet, the Briseis making steady headway with the enterprise of uncovering the drift on the lead where it makes into the Ringarooma leases. There should be years of work here and it seems absurd to imagine that the lead will lose its values in the few yards that separates the old mine from the new area.

Minerals Separation.—The progress of this process is becoming notable. Attention has recently been attracted by the use of a thin oil derived from the local eucalyptus trees. This is much cheaper than imported petroleum.

THE BULLFINCH EXCITEMENT

(By Our Melbourne Correspondent.)

SINCE the days of the Londonderry affair at Coolgardie nothing has excited such interest as the strike of rich ore in the Bullfinch claims at Southern Cross, Western Australia, held by Messrs. D. L. Doolette, V. F. Shallcross, C. Jones, and party. The latest story is that Mr. Doolette, who holds $\frac{13}{16}$ of the property, has refused an offer of £500,000 for the four blocks that he has acquired. A month ago little was known of the claim beyond the fact that it had a prospecting chance, but within the past fortnight news has gone forth that samples ranging up to 400 oz. per ton have been obtained, that bulk assays over a width of 24 ft. from No. 1 lode have given 21¼ oz. gold per ton, while from the No. 2 shaft on another lode three samples taken across the formation have yielded up to 151¼ oz. per ton. When sampling results such as these bore the imprimatur of the Government Geologist of Western Australia, the public suddenly realized that there was something more than newspaper reports to be considered. On top of Gibb Maitland's report that the mine was the richest he had seen in the West came endorsing assertions from Richard Hamilton of the Great Boulder and W. J. Loring of Bewick, Moreing & Co. The public of Western Australia has been waiting for the past five years for some mineral development that would once more restore the State to the proud position it formerly occupied as a centre of mining and speculative activity.

While this was the feeling in Western Australia, in South Australia a mild form of frenzy was generated. Members of the Stock Exchange interested themselves largely in one or two syndicates and so were early in the field securing options for applications for leases over blocks surrounding the Bullfinch group held by Mr. Doolette and his partners. In South Australia the people are exceedingly prosperous and having made large sums out of Broken Hill first of all and secondly out of early ventures in Western Australia, and not having had a mining fling for several years, they too were in the mood to embark in such speculative risks as the syndicates were able to offer. So for the past ten days flotations of the most reckless nature have been carried through. Blocks east and west, north and south, have been promoted into companies without it being known first of all that the lease would be granted, secondly, whether they were on the strike of the lode, and, thirdly, whether there was the least prospect of pay-ore being found on any formation existing on the claims. Melbourne was slow in following the lead set by Adelaide, but it too, though in a lesser degree, joined in the gamble. Sydney was less responsive. The promoters have had a good time, so good indeed that the attention of the Premier of South Australia has been directed to the gambling that has been carried on, and he has been asked in Parliament to take steps to prevent such reckless speculation.

The work done on the Bullfinch claim has certainly disclosed an exceptionally rich patch. The story that it is the richest the world has seen has yet to be proved. It would be hard to beat the record of some of the old Hill End mines, in New South Wales, or some of the yields from the bonanzas on the Thames goldfield, in New Zealand, at Wood's Point, in Victoria, or even the ephemeral richness of the old Coolgardie mines, or the great oreshoot of the Lake View Consols.

The maps available indicate that Mr. Doolette has been careful to peg out blocks so as to command any continuation of the oreshoot for a long distance. This fact indicates how great is the gamble on the part of those who invest in position blocks, especially when it is remembered that it is not definitely determined in which direction the lode trends. One visiting expert writes that the development may lead to substantial results on some of the leases outside the original blocks, but at this juncture the chances are purely a gamble. He adds that no strike of much importance had been made outside of the Bullfinch lode up to the time of his visit, and he mentions that the occurrence of the gold is due to a cross-faulting of the country, practically in contact with granite. This opinion comes from a man of considerable experience and as he joins with all the other visitors in testifying to the exceptional richness of the ore exposed in the parent claim, his opinion is worth placing on record. It must be added that some of the leading men who have visited the locality preach caution in regard to the outside blocks.

The result of the boom has been that 16 miles of country on the supposed lode has been pegged out. Promoters have been helped by the fact that Bewick, Moreing & Co. have acquired properties farther away in the district and have taken options over others. It is believed that they made an offer to Mr. Doolette for the right to mine under 100 ft. at the Bullfinch leases but that he would not consent to such a proposal.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

November 1910.	October 1910.	November 1909.
£57. 15s. 4d.	£56. 16s. 2d.	£58. 19s. 4d.

Politics in America and England have exercised a disturbing influence on the course of business, but the statistical position shows a steady improvement both in America and here. The world's stocks for October declined 10,000 tons, and the decrease since January amounted to 21,719 tons. Disappointment was expressed at the continued heavy American production, but it is explained that this arises from old accumulations and the mines are now raising less tonnage for future delivery to the refineries. The total world's official stocks amount at present to about 150,000 tons, or two months' consumption, which is only a moderate reserve.

The month commenced with great activity and the persistent demand induced producers to raise prices moderately. Unfavourable developments on Wall Street following the elections, however, combined with pessimistic views as to the returns of the United States refineries produced a reaction in sentiment which depressed prices once more to £58 for three months. A recovery took place to £59 and the price remained steady until the pessimistic pronouncements of a prominent railway magnate brought about a general decline. The final price for the month is barely £58 for three months copper. Producers appear to be confident of an early revival in inquiries. They are well sold for this year and into January and are encouraged by reason of the decrease in stocks to hope for a revival of prices.

TIN.

Average prices of cash tin:

November 1910.	October 1910.	November 1909.
£166. 18s. 0d.	£164. 14s. 9d.	£140. 0s. 3d.

This much manipulated market still continues to show advances in prices. It is still controlled by the bull syndicate who find their justification in the excellence of the demand and the moderate supplies coming forward from the East. Commencing at £165. 10s. prices were raised through daily fluctuations of bewildering extent until £174 was realized on November 30 for large quantities for shipment from the East to American consumers. Various rumours circulated of decreased consumption and of the closing of tinplate works in America were followed by realizations in this market, but any serious lapse in prices was prevented by the bulls. The statistics for November show an increase of 2000 tons, but it has been ascertained that the deliveries have been considerably underestimated and that the monthly figures would make a good showing. Prices closed for the month at £172. 10s.

LEAD.

Average prices of soft foreign lead:

November 1910.	October 1910.	November 1909.
£13. 4s. 6d.	£13. 2s. 0d.	£13. 1s. 4d.

A further advance in price has been registered during November and large sales were made in the early part of the month at £13. 10s. for January. Since then the demand has shown a fall due to the usual endeavour on the part of the trade to end their financial year with minimum stocks. These are now low and a resumption of buying on a large scale may be expected.

SPELTER.

Average prices of ordinary brands:

November 1910.	October 1910.	November 1909.
£24. 1s. 9d.	£23. 16s. 6d.	£23. 2s. 1d.

The international spelter syndicate to control the sale of this metal has been renewed for a number of years. This will no doubt be viewed with favour by the bulk of consumers on account of the steadiness it lends to prices. It is a distinct gain to the market to be freed from the violent fluctuations brought about by contending interests to obtain control. Prices remain steady with a moderately good demand and a scarcity of unsold metal.

OTHER METALS AND MINERALS.

Prices quoted on December 10:

SILVER.—25¼d. per oz.
PLATINUM.—160s. per oz.
BISMUTH.—7s. 6d. per lb.
ALUMINIUM.—£71 per ton.
NICKEL.—£167 per ton.
COBALT.—9s. 9d. per lb.
ANTIMONY.—£28 per ton.
QUICKSILVER.—£7 10s. per flask of 75 lb.
MANGANESE ORE.—8d. to 9d. per unit (1%).
IRON ORE.—Cumberland hematite 20s. per ton at mine. Spanish 21s. delivered in England.
PIG IRON.—Cleveland 49s. 9d. per ton. Hematite 63s. 6d. per ton.
WOLFRAM ORE.—35s. 6d. per unit (1%).

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Testing Slime.

The Editor:

Sir—In your issue for August you published an article on testing slime, by Mr. G. J. Young, describing the use of the laboratory centrifuge for this purpose. To confirm his opinion of the value of this method I may say that it has been in almost daily use in the assay office of the Homestake mine since 1904, and has been introduced at a number of western cyanide plants by metallurgists who have seen it there. It was devised for the purpose of quantitatively separating *minus* 200-mesh material, into 'granular,' 'angular,' or 'quick-settling' particles on the one hand and 'flocculent,' 'amorphous,' or 'slow-settling' particles on the other. This it does more rapidly and efficiently than any other method I know. It is applicable to small samples; two grammes of material suffice for a test, and duplicate results, if made under standard conditions, usually agree within 1%. The principle was originally applied by one of our assistants, T. Kaderly, who had used similar methods on paints, and the application of the centrifuge used by physicians was suggested by A. J. Clark, who evolved a standard method. A full description was sent by him to the Standardization Committee of the Institution of Mining and Metallurgy, but it was never printed.

W. J. SHARWOOD.

Lead, South Dakota, November 7.

Rooderand Gold Mining Co.

The Editor:

Sir—My attention has been called to two articles from your Johannesburg correspondent, with reference to the above-named company, published in *The Mining Magazine* of December 1909 and August 1910. To those articles, so far as they refer to myself, I take the strongest objection; and this for the reason that the extracts alleged to be from reports made by me are not to be found therein. In several instances it is stated that I have made use of expressions and drawn conclusions which, in point of fact, do not appear in either of the reports referred to. For instance, the statement that I refer to the "Witwatersrand Main Reef system" is not only inaccurate, but absurd. This expression certainly does not appear in either of my reports; nor do I state "that the reef on which the payable results have been found belongs to the Witwatersrand Main Reef system."

A geological system, as you are aware, consists of a succession of beds, some of which are sometimes grouped together into series, and these series therefore form part of the system. For the same reason the Main Reef series form part of the Witwatersrand system, and the name "Witwatersrand Main Reef system" is accordingly a blunder; but it is not a blunder made by me, as you can gather from my reports. Further, I maintain that it is not possible, from these reports, to fairly draw the conclusion that the seven reefs therein referred to—the one of the centre I describe to avoid misunderstanding as the "Middle Reef"—lie in the "Witwatersrand Main Reef system."

Then again the word "tentative," with reference to which your correspondent makes some sarcastic remarks, is not once used in either of the reports; nor do I anywhere make use of the expression "new reef." In fact, there is nothing to warrant the statement that I had discovered a "new reef." On the contrary, what I do state clearly and conclusively negatives any such suggestion. Moreover, the word "yield," on which your correspondent comments more than once, is not an expression of mine, and I give no values except where I state on the second page of the first report as follows: "The Kimberley Reef series is represented by a number of reefs (conglomerate beds) twenty in all, some of them of great thickness, 6–8 ft. and giving *panning results* of 6 dwt., whilst one reef 10 in. thick gives 5 dwt."

I may add that my reports were only prospecting reports made during the first two months of the work on the property and should have been referred to as such. The statements attributed in your article to the secretary, especially those with regard to values, may possibly have been gathered from a report by Mr. Hoffmann, to whom I handed over the work in August 1909; but they certainly cannot be gathered from anything that I have written.

Your articles have done me considerable injury in my profession as a geologist of many years standing; and I trust you will do me the favour of publishing this refutation of your correspondent's misstatements in an early issue of your Magazine.

I enclose herewith copies of my reports.

E. JORISSEN.

Salisbury, October 20.

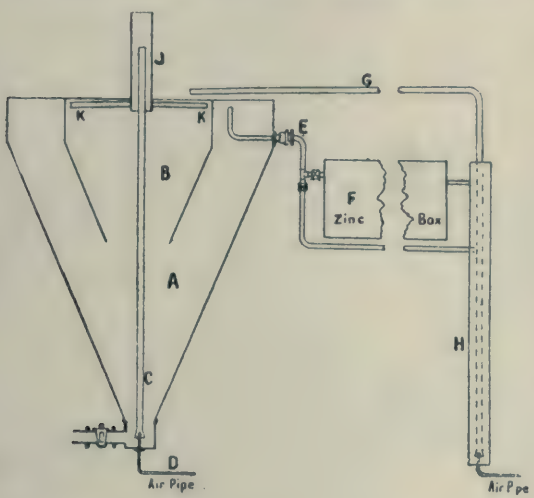
[We are glad to give Mr. Jorissen the opportunity to correct any erroneous quotation of his views, but we note that our Johan-

nesburg correspondent stated that the text of his report was not available and he expressly quoted from an announcement made by the secretary of the Rooderand company. Mr. Jorissen is referred to the latter gentleman.—EDITOR.]

Slime Agitation.

The Editor:

Sir—In the October number of your magazine, p. 303, I note that Mr. W. C. Paterson, of Denver, has invented a new agitating vat for the treatment of slime. In November last I read a paper before the Chemical, Metallurgical, and Mining Society of South Africa describing an apparatus devised by me for drawing off clear solution obtained between



the outside shell of the vat *A* and an inner cylindrical or conical body *B*. You gave an abstract of my paper in your February issue and reproduced the drawing showing that the circulation and agitation of the slime is effected by an air-lift. In a pamphlet which I published early in 1909 I showed a method of circulating the slime by means of a centrifugal pump which drew the slime from the bottom of the conical vat and delivered it into the space within the internal cylinder. As a matter of fact my patent specification covers agitation either through the centre of the vat or from outside, and by either air-lift or pump.

ANDREW F. CROSSE.

Johannesburg, November 14.

[When we first read the article describing Mr. Paterson's new agitator, our mind reverted to the paper read by Mr. Crosse and at first sight one process seemed to be a replica of the other. On further inquiry we found that Mr. Paterson's object was not to obtain a clear solution suitable for the zinc-boxes but one which would enable him to circulate the slime without sending gritty matter through the centrifugal pump. The later drawing by Mr. Crosse shows that an air-lift was substituted for the pump for the purpose of circulating and agitating the slime, no doubt the wear of the pump having tended to favour an air-lift. Mr. Paterson contends that the air-lift is disadvantageous because it often introduces too great an aerating effect. These opinions were formed by us prior to inserting the notice of Mr. Paterson's plant and of course are quite without prejudice as far as the rival contentions of the two inventors are concerned.—EDITOR.]

Income Tax.

The Editor:

Sir—This is a subject which I have so far not seen touched in the Magazine, although it is of interest to many mining engineers and secretaries of mining companies. Companies and firms operating mines have a great grievance with the existing method of computing profits for the purpose of assessment of income tax, inasmuch as no allowance, as representing a fixed percentage of the depreciation on the cost of shaft sinking, is permitted to be deducted from the gross profit. Shafts are obviously wasting assets, because they often need to be superseded when the surrounding orebody has been exhausted, and it is only proper and also good finance, that the cost should be gradually written off by means of annual depreciation, as is recommended by the Institution of Mining & Metallurgy, and generally adopted in one form or another by the principal mining companies. However, such depreciation is not allowed, and it behoves the organizations representing mining engineers to join in the agitation, at present being carried on by the Chambers of Commerce throughout the country, for the reform of Income Tax Acts, and their administration. I notice that recently the Chambers of Commerce for Glasgow, Newcastle, and Birmingham have urged the appointment of a special committee, to deal with the whole question of income tax reform. How is it that the powerful institutions representing the mining engineers of this country have not joined in this agitation for reform? It is even yet not too late, and I trust they will back up the demands of the other bodies.

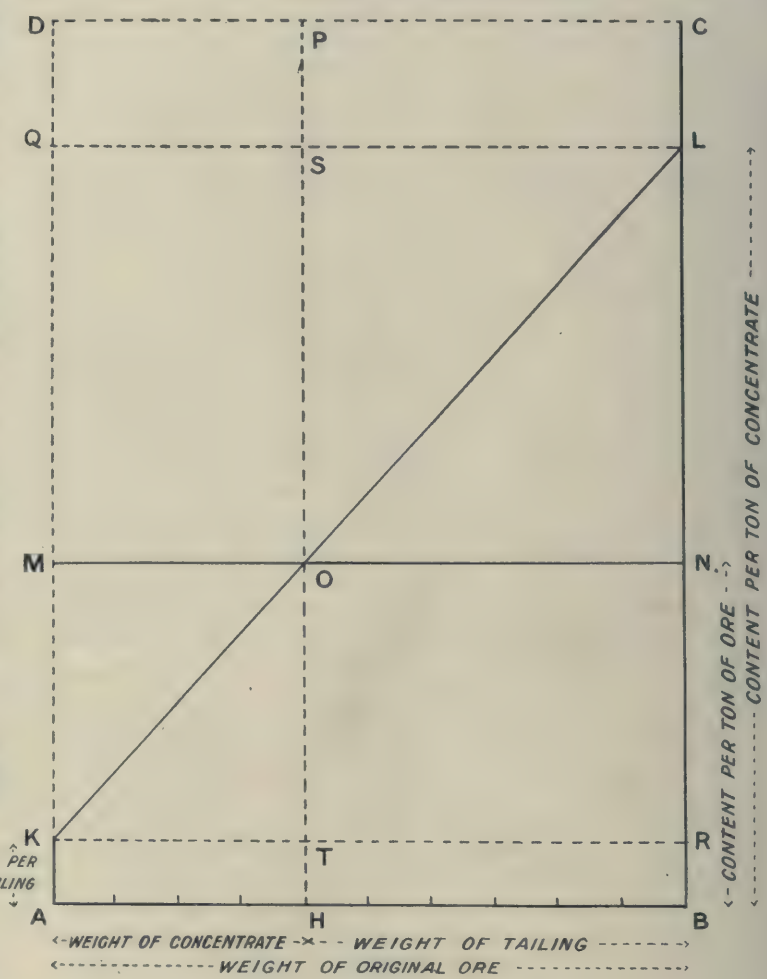
HAROLD E. FERN.

London, December 6.

GRAPHIC METHODS FOR CONCENTRATION

By W. J. SHARWOOD

MANY problems involving the ratio and efficiency of concentration can be readily solved by graphic construction. The method is to construct a rectangle $ABCD$ on a base AB, this base representing on any convenient scale the weight of ore. If the ratio of concentration is under discussion, AB is made 100. AB is divided at H, AH representing the weight of concentrate produced, and HB the weight of tailing. On the adjacent sides of the figure, AK is set off to any convenient scale representing the content per ton of tailing, and BL the content per ton of concentrate. Each content is set off at the reverse end to that representing the corresponding weight. Also AM is taken to represent the content of the original ore on the same scale, and MN is drawn parallel to AB; HP is drawn parallel to AD. If now we join the points KL, the three lines KL, MN, and HP all intersect at one point, O.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errors in drawing. It is equally true that the results obtained by computation in similar cases will be similarly uncertain, and will often fail to check with the other figures obtained in actual work.

When a large sheet of closely ruled cross-section paper is used for such a diagram, the diagonal *KL* is usually the only line required to be drawn, all the other points being set off or read direct from the rulings.

In order to forestall any possible charge of plagiarism I hasten to state that the principle involved is fully set forth by Euclid in his forty-third proposition. If the diagram is completed it is readily seen that the area *ABNM* represents the total value in the ore, *HBRT* that left in the tailing, and *AHSQ* that in the concentrate. The rectangle *TRNO* is equal to *MOSQ* and may be looked upon as representing the content transferred by concentration from the tailing to the concentrate.

Mineral Production During 1909.

The report by R. A. S. Redmayne, chief inspector of mines, on the output of metals and minerals in the United Kingdom during 1909 was published last month. The most important mineral produced is coal, of which the output was 263,774,312 tons valued at pits mouth at £106,274,900. These figures compare with 261,528,795 tons and £116,598,848 during 1908. Of the year's output 4,258,980 tons was anthracite, similar to that found in Pennsylvania; this was mined chiefly in the district to the north of Swansea, but some also came from Scotland and Ireland. The amount exported was 65,694,267 tons. How large a proportion of the mineral wealth of the country is supplied by coal may be judged by the fact that the total value of all the minerals produced was £119,394,486. The output of iron ore was 14,979,979 tons valued at £3,869,777, figures not much different from those of 1908. The iron ore imported during the year amounted to 6,328,623 tons valued at £4,986,360, of which 75% came from Spain. In addition to this 593,301 tons of purple ore was used, that is, the iron oxide residue from burnt pyrite. The total production of pig iron during the year was 9,531,987 tons as compared with 9,056,851 tons the year before.

The output of lead showed a slight increase, the figures being 29,744 tons of concentrate containing 22,463 tons of metal, as compared with 29,249 tons and 20,999 tons the year before. The production of silver from this ore was 142,006 oz. during 1909 and 135,154 oz. in 1908. The most productive mines are the Mill Close in Derbyshire, the Boltsburn in Durham, the Rhosesmor and Bryn-Celyn in Flint, the Queensberry and Leadhills in South Scotland, and the Foxdale in the Isle of Man. The imports of ore during the year were 15,542 tons and of pig and sheet lead 207,660 tons.

The output of zinc ore in the United Kingdom continues to shrink. The figures were 9902 tons of concentrate as compared with 15,225 tons during 1908, and 20,082 tons during 1907. The Cumberland and Flint mines are producing much less than formerly and the largest output was 1876 tons from the Great Laxey, in the Isle of Man. The amount of zinc ore and concentrate imported was 73,814 tons, as compared with 60,687 tons the year before, the chief countries sending it being Italy, North Africa, and Australia. In addition 121,552 tons of zinc was imported during the year, chiefly from Belgium and Germany. A small amount of zinc, 5314 tons, was imported from the United States, as was also 2622 tons of zinc ore. The amount of ore imported from Mexico was 596 tons. The only place where electrolytic zinc is produced in the British Isles is at Northwich, where Brunner, Mond & Co. extract a remarkably pure zinc by the Hoepfner process.

The output of tin continues to increase slightly, and stood at 8289 tons, as compared with 8008 tons in 1908 and 7080 tons in 1907. The figures are higher than any since 1895. The recoverable metallic content was 5193 tons. The value of the output was £617,376. The largest producer was Dolcoath with 1904 tons; then came Carn Brea and Tincroft with 1106 tons, Basset with 844 tons, South Crofty with 682 tons, Grenville with 633 tons, East Pool with 586 tons, Levant with 422 tons, Wheal Kitty with 241 tons, and West Kitty with 230 tons. The amount of tin ore and concentrate imported was 24,086 tons, of which 14,886 tons came from Bolivia. In addition 41,725 tons of metallic tin was imported, 36,084 tons of which came from the Straits.

Of other metallic minerals the production was: Wolfram 376 tons, manganese ore 2768 tons, copper ore 3531 tons, bauxite 9500 tons, and uranium ore 6 tons. The output of white arsenic during the year was 2880 tons worth £28,187, as compared with 1936 tons worth £19,190 during 1908. The largest producer was Wheal Friendship near Tavistock, with 711 tons, and other producers were South Crofty 707 tons, East Pool 520 tons, and Carn Brea and Tincroft 362 tons.

PERSONAL

A. W. ALLEN, recently in Mexico, sailed for Uruguay on December 13.

SYDNEY H. BALL, on his return from Atbasar, Siberia, sailed for New York on November 23.

A. C. BEATTY expects to be in London during January.

HENRY BRELICH has returned from New Zealand.

A. O. BROWN has been appointed manager for the Guide Mining Co., in the northern Transvaal.

R. GILMAN BROWN returned from Atbasar, Siberia, on November 12.

L. N. B. BULLOCK is on his way to Mexico City, going to Cobalt first.

LOUIS CHEVRILLION is at Paris.

J. PARKE CHANNING is inspecting some of the important copper mines of Michigan.

J. V. N. DORR, of Denver, expects to sail for New York on December 24.

FRANCIS DRAKE is here from San Francisco.

GEORGE E. FARISH, on his return from Alaska, has been to northern Mexico.

W. R. FELDTMANN has returned from Ashanti, West Africa.

WILLIAM FRECHEVILLE has returned from a visit of inspection to Porcupine, Ontario.

G. A. GUESS has left Tennessee to become superintendent at Cerro de Pasco.

W. PELLEW HARVEY is due from India.

F. O. HARVEY, of Harvey & Wilbraham, has returned from Arizona.

J. A. L. HENDERSON has returned from New Brunswick.

MARK R. LAMB is at Callao and expects to visit Ferrobamba, in Peru.

H. W. LAWS has been appointed advisory engineer to the Northern Nigeria (Bauchi) Tin company.

LIONEL LINDSAY has returned to San Francisco from Mexico.

W. J. LORING has returned from Australia.

F. A. MALINS is manager of the Metates mine, in Sinaloa, Mexico.

C. W. MERRILL, after a visit to France and the Riviera, will sail for New York on January 7.

J. W. D. MOODIE has been appointed general manager for the Tintic Mining & Development Co., Utah.

F. L. MORRIS, of San Francisco, is now at Wellington, New Zealand.

C. H. MUNRO has arrived at San Francisco from Alaska.

P. N. NISSEN sailed for South Africa on December 3.

W. SEYMOUR PEARLESS sailed for Salisbury, Rhodesia, on November 26.

ARTHUR L. PEARSE is due to arrive from Alaska.

C. W. PURINGTON was at St. Petersburg last week.

R. M. RAYMOND left for New York on November 30, returning to Mexico City.

THOMAS T. READ, who is to be assistant editor of the *Mining and Scientific Press*, has been visiting the gold mines of France.

F. B. REECE is at Pachuca.

HENRY G. SCOTT is on his way to Siam.

H. KILBURN SCOTT is in Brazil.

S. A. R. SKERTCHLY has been appointed resident manager for the Los Reyes Mines, in Jalisco, Mexico.

EDWARD STABLES has returned from British Guiana.

NORMAN C. STINES left for St. Petersburg on November 23 on his appointment as engineer with the Russian Mining Corporation.

G. A. STOCKFELD has returned from the Gold Coast.

ARTHUR TAYLOR is in India.

H. A. TITCOMB is expected in London soon after Christmas.

WILLIAM TRURAN has returned from Turkey, and will return thither after the holidays.

H. W. TURNER returned from Korea by way of Siberia and spent a few days in London.

CLAUDE VAUTIN left London on December 10 for South America.

S. S. WEBB-BOWEN left on December 7 for the Dutch East Indies.

W. H. WILEY is examining the Ferrobamba mines in Chile.

GILBERT WINSLOW has returned to London from the Ivory Coast, West Africa.

MINING IN WESTERN AUSTRALIA

By A. MONTGOMERY.

*WESTERN AUSTRALIA is a vast country, justly described as one of "magnificent distances." It comprises 975,920 square miles, and extends over 21 degrees of latitude, the north part being within the tropics (in 14° south latitude) and the south approaching the cooler portion of the temperate zone (in 35° south latitude). The climate, therefore, varies greatly in different parts of the State. There is a good rainfall along most of the west coast, averaging 30 to 40 inches annually, but as we go inland it decreases, and on about 57% of the area of the State the annual rainfall is under 10 inches. Sub-arid conditions therefore prevail in a large portion of the interior, and provision of permanent supplies of fresh water becomes a first necessity of settlement. There are no high ranges in Western Australia, the altitude of its highest portion being only about 4000 ft. The greater part of the interior of the country consists of plains 1000 to 1500 ft. above sea-level, broken by low ridges and island-like low hills. Over the main portion of the central and eastern goldfields there are few outstanding ranges of hills of any magnitude, but from Peak Hill northward the country becomes much more hilly, and distinct mountains of some altitude are often visible. In the south of the State also there are some fairly high and steep mountain ridges. There is, however, no great range sufficient to form a source of permanent rivers, and, except in the north-west and south-west regions, where there is a good rainfall, running streams are unknown except during rains. The plains are generally flat basins dipping toward depressions occupied by salt lakes and saline clay-pans. On the edges of these plains the precipitous escarpments 10 to 50 ft. high, known locally as breakaways, mark the margins of old lake basins of which the plains were the bottom. At the top of the escarpments are small plateaux, often level, which are relics of an older marine plain, and on these there are frequently sand dunes, fringing the old lake-basins. In the lake-basins the bedrock is often at a shallow depth beneath the surface, or even out-cropping, but frequently it is covered with detrital material, many wells being sunk 70 to 100 ft. before reaching bedrock. It is plain, therefore, that in those old lake-basins there has been a great deal of levelling of old hollows in the bedrock with detrital material.

In the districts of the south-west portion of the State, where there is a fairly good rainfall, there are extensive forests of heavy timber, and more inland there are still good timbered belts, which provide excellent firewood and mining timber. In the Murchison and Mount Margaret districts, however, the heavier eucalyptus is replaced by small trees (mulga), which supply good firewood and make useful but not first-class mining timber. Still farther north the country becomes open, and is covered with various varieties of grass and spinifex, forming good pastoral country. In these parts it is often difficult and expensive to procure mining timber and firewood, the trees being confined to narrow belts along the main watercourses. The country is, as a rule, remarkably easy to traverse, there being little or no difficulty, other than that of obtaining water, in taking vehicles over it in any direction without having to make roads. The bush can be traversed quite readily in a buggy, or even, in a good many places, in a motor-car. This explains at once the extraordinary way in which the goldfields were over-run by prospectors within the first ten years of the gold discoveries. It also explains why it is possible to lay down railways for not much over £1500 to £1800 per mile.

Gold and other minerals are found all over the explored portions of Western Australia, the principal metallic minerals being gold, tin ores, copper ores, lead ores, and iron ores, while coal is the most important non-metallic mineral. The metallic minerals occur in old igneous and sedimentary rocks, the geological age of which is not yet determined, beyond that it is pretty certain that the most of them are older than the Cambrian period. There is a complex system of exceedingly ancient metamorphic rocks mingled with igneous intrusives, many of which have become converted into schists, and which may be roughly grouped together as the auriferous greenstones. Breaking through these there are great granitic intrusions, which, in turn, have

*Abstracted from a paper read before the Royal Society of Arts on November 29 by the State Mining Engineer to the Government of Western Australia.

been pierced by later dykes, both acidic and basic, of different ages. Lying unconformably on these oldest rocks, we find here and there throughout the country small patches of a younger but still extremely old formation of sedimentary slates and schists (known as the Mosquito Creek series), and apparently of later date than these are the fossiliferous Cambrian beds of the northern part of the State. In the north also we have a large development of Devonian rocks, and in the north and west considerable areas of Permo-Carboniferous strata. In the most southerly of these last the Collie collieries have been opened up. The occurrence of patches of Cretaceous marine strata and Tertiary to Recent limestones in widely-separated parts of the State shows that much subsidence and elevation of the country must have gone on since the coal measures were laid down, and numerous physiographical and geological considerations have led me to the conclusion that the country owes the present shape of its surface very greatly to the fact of its having been wholly or in great part submerged beneath the sea within post-Tertiary times.

Except for coal, phosphate rock, gypsum, salt, bauxite, and some few other minerals, and when considering the distribution of alluvial gold and tin ore, we may put to one side, from a mining point of view, all the country occupied by the strata of later date than the Devonian. In the Devonian system we have series of auriferous conglomerates (the Nullagine conglomerates), which are in many respects closely analogous to the bankets of South Africa, and it is interesting to note that in these beds the gold is of alluvial origin, derived from the erosion of the underlying Mosquito Creek and auriferous greenstone series, both of which teem with auriferous veins. The Devonian and later strata are comparatively little crumpled by orogenic movements, and show lttle, if any, evidence of ever being penetrated by mineral veins, and it seems clear that the period of formation of the mineral veins in the older rocks was long anterior to the Devonian, and probably also to the Cambrian period. All the pre-Cambrian strata, whether igneous or sedimentary, are greatly plicated and contorted, the axes of folding running north-north-westerly in the southern part of the State and north-easterly in the northern, conformably with the general direction of the western coastline. The complex of ancient intrusive and metamorphic rocks in which the mineral veins occur, and which we now find at surface, were doubtless once deep in the base of a rising region, probably forming a mountain chain like the Swiss Alps or the Cordilleras of South America. There is much reason to regard it as most probable that the quartz veins carrying the gold and minerals were of deep-seated origin, most of the vein-stuff being sheared country rock transmuted into quartz by metasomatic change. Most probably they are the result of pneumatolytic processes operating—in connection with volcanic activity—during the period of mountain-forming movement, which was certainly mainly pre-Devonian and probably pre-Cambrian.

The principal gold discoveries may be arranged in belts, which correspond with the general axes of folding of the oldest strata. It is noteworthy that the main granitic areas have so far been found to contain few mineral veins, and that the latter are usually in the greenstone schists and dioritic intrusives not far from the contacts with the granite. When payable mineral veins have been found in the granite they have been quite close to the greenstone contacts. Many of these have probably been lines of severe faulting, the greenstones along the contact being much sheared and foliated, and the granite being also in some cases converted into schist, which a short distance away soon merges into gneiss and granite. Some of these shear zones along the granite contacts are of great length and persistency, one passing through Southern Cross, for example, being traceable for over 60 miles at least, and they are notable as containing several important mines, and numerous smaller auriferous veins.

The British investor, however, naturally looks at Western Australian mines from a shareholder's point of view, and here we come in contact with many considerations which tend to obscure the fundamental issues. The market-value of mining shares depends on popular estimation from time to time, and fluctuations in value by no means necessarily indicate the true position of affairs at the mine. Many people make and lose money by dealing in mining companies' shares, and put their gains, and more especially their losses, down to "mining" when they are simply due to share-dealing. One may buy stock in a profitable mine at so high a figure that the dividends give an entirely inadequate interest upon the investment, but in such a case it is not the mine which is at fault, but the investor's own judgment. To try and get at some of the leading facts of the case from a purely industrial point of view, let us look at the amount of

THE GOLDFIELDS OF WESTERN AUSTRALIA.

dividends paid by Western Australian gold-mining companies in comparison with the total production. It will be seen that the average return has been 22·1% of the total produce, and that the dividends have ranged from 18 to 26·1% of the total production, which is a very favourable showing for any industry. The profitable nature of the gold-mining industry is well shown in another way by stating that the average value of gold produced per man employed, both on surface and underground, was £444 in 1908 and £413 in 1909.

Taking another basis, I find in the annual report of the Mines Department for 1909 that dividends were paid by 20 gold-mining companies, the total share issues of which amounted to 6,961,663 shares paid up to £6,913,560. Their dividends for 1909 were £1,359,115, equal to an average of 19·7% of the paid-up capital. This is surely a very profitable return on the money invested in these companies. I regret that I have not been able to get hold of any reliable estimate of the total capital contributed by companies toward exploiting the mines of Western Australia, and it would be still more difficult to arrive at any true valuation of the amount of cash actually spent in the country—which is the true industrial basis upon which the proportion of dividends should be calculated. The 20 mines referred to are, however, the largest and most important in the State, and it is improbable that the actual expenditure from capital in the case of the other non-paying and extinct companies has greatly, if at all, exceeded the £7,000,000 spent in the equipment and development of the large producers. The total amount of dividends paid, say, £20,000,000, must be now greatly in excess of the total cash laid out by the investors from capital in *bona fide* mining operations. I am not speaking of the return on the nominal capital of the many companies that have failed in the State in the past, as calculations on that basis seem to me to belong to the province of share-dealing, and not to mining as an industrial process, and in claiming that the Western Australian mining industry has been a highly payable one on the whole to those who have invested in it, I rest my case on the fact that far more money has already been repaid to the investors in dividends than they have laid out from capital in opening, equipping, and exploiting the mines.

When one considers these results, it is somewhat difficult to understand the adverse attitude which has prevailed in the London mining market for some years toward Western Australian mining ventures. There is no question but that they have been greatly out of popular favour, and there seems to be a general feeling among investors in England of great distrust of the country and disinclination to even listen to representations in its favour. One reason of this was, no doubt, the multitude of unsuccessful West Australian mining companies that were floated in the earlier days of our goldfields, from ten to fifteen years ago, through which the investing public suffered heavily. In regard to these, nevertheless, it is only just that a careful distinction be made between the losses made in stock-dealing and the actual losses on mining work. In many cases it will, I think, be found that the heaviest portion of the losses of the shareholders was the money paid to promoters and others in forming the companies and in their own market-dealings in the shares. Frequently many causes co-operated to make the ventures unsuccessful, and it is by no means either fair or reasonable to jump to the conclusion that because a mine proved unsuccessful it was necessarily an obvious 'wild-cat' from the inception. That there were some frauds deliberately put upon the market is likely enough, as has been the experience in every mining 'boom' in every other part of the world as well, but it is rather surprising to find what a large number of cases there are in which mines opened by companies some years ago and abandoned by them as worthless have been since worked profitably. Many of the so-called 'wild-cats' were guilty of nothing worse than being prospects greatly over-rated by their discoverers and promoters, and the public who rushed to invest in them without sufficient examination were almost as much to blame for their lack of ordinary and reasonable caution as were the promoters who offered them the bait. This sort of thing happens in all 'booms,' and seems quite inseparable from mining-company promotion as the world is at present constituted. Many of the ventures were entirely premature, the grade of ore in the mines being unworkable profitably at the time they were taken up, though since then, under better conditions, it has been possible to re-open several of them to advantage; many were failures due to want of experience of ore deposits with the peculiar local features presented by the lodes of the West Australian fields; some were very badly managed, and some with brilliant surface prospects, as they were opened, became too poor to be followed up. It is in the nature of mining that there can be no certainty as to values in ground which has not been well proved by

systematic development, and when undeveloped 'prospects' are undertaken there is necessarily much risk that they may turn out badly rather than well. When an unproved property is taken in hand for mining purposes it is always well for the investors to have their minds made up that the risks of disappointment are very great, and to be prepared to follow a policy of first proving their ground well before launching out into much expenditure on plant and permanent development. It will often, in such cases, be found advisable to do a good deal of work upon quite a number of promising 'prospects' before settling down in permanent fashion upon one or more of them. In the earlier days of the Western Australian boom—as in all similar cases—this elementary precaution was quite overlooked, and investors rushed madly to pay large sums for ground on which practically nothing had been proved and the value of which no man living could predict. The country is full of lodes and mines carrying more or less gold, and worth more or less prospecting, and in most cases when gold has been found in the outcrop it is quite impossible for any one to predict with any certainty whether the lode below it is going to be a good one or not. Many good-looking outcrops have proved disappointing when sunk upon, and conversely poor surface indications have frequently been found to cover excellent ore in depth. No one can tell how they will turn out without a good deal of development, and in the early days this was almost entirely overlooked, and investors found themselves committed to the working of reefs for which they had paid high prices, but which they would not have undertaken seriously if they had done some preliminary work upon them before completing their purchase. In such circumstances it is natural that the owners should persevere with undertakings that would be much better left alone after the first preliminary workings have shown that the prospects were not so good as anticipated, and much money has been uselessly expended through a creditable but mistaken notion of pluck. The owners find themselves committed to a venture and determine to see it through, for better or worse. Many good mines have been found by such perseverance, and in many aspects it is highly commendable; but investors should take such risks with their eyes open and not give way to excessive disappointment if their efforts result in failure instead of success.

Since the earlier days a great deal of valuable knowledge has been obtained as to the behaviour of the lodes of Western Australia which was not well understood at first, and there is not much fear now that the mistakes of former days will be repeated by any careful and experienced manager. Purchasers now very properly demand time to thoroughly satisfy themselves about the prospects of the properties offered to them, and do not usually complete their bargain until they have themselves developed the mines to some extent on an option of purchase. Many reefs are often thus examined before a purchase is finally completed, and the industry is put on a far sounder basis in consequence.

One good reason, therefore, why the local residents do not themselves do the preliminary work of prospecting before inviting capital to come to their assistance in mining development, is that they are doing all they can already, and that the field is far too vast for the means of a small population. At the same time great attention is being paid to opening up the land of the State, and great numbers of people who might otherwise have money available for mining have their hands quite full in fencing, improving, and stocking the virgin country which they have taken up. For their numbers and means it will be found that the people of Western Australia are quite as enterprising in mining ventures as any of their neighbours, and are doing all they can, but they can only do but little in such a vast field. For every man now engaged in mining, I am convinced that the fields could easily support ten if they were adequately developed, but both population and capital are required before this can be brought about. There are great opportunities waiting to be seized, for both capital and labour, in developing these fields. One is no use without the other, nor either without what has been well termed the third leg, which gives stability to the industrial stool—brains and knowledge. But if capital and labour can be made to work together under intelligent and skilled organization there is no doubt whatever that the conjunction of effort would result most satisfactorily in a field of such great potentialities as the Western Australian goldfields.

There is still much unexplored country in Western Australia to attract adventurous people who desire to look for new goldfields. At the present moment the feeling in the State is rather that it is advisable to further prospect the known fields than to go to places in which it would be difficult to work profitably any discoveries that might be made, on account of their distance from lines of communication.

PROSPECTING IN THE NORTH

By HORACE V. WINCHELL.

FREQUENT mention has recently been made in the English Press of the important discoveries along the Pacific coast in British Columbia. The extravagant claims made by promoters have received just criticisms chiefly on the ground of the development being insufficient to warrant these claims. In this connection it may be of interest to point out in simple terms some of the other reasons why the region in question might look more attractive to the prospector than to a student of economic geology. Indeed, it may be useful to call attention to a few principles based upon chemical facts, which have a universal application, and yet are not always taken into consideration by the mining engineer.

It will at once be admitted that the value of a mining property can be demonstrated only by development; and the greater the amount of development the more reliable and complete may be the engineer's report. But engineers and geologists are frequently called upon to examine undeveloped or but slightly developed mining propositions; and their opinions must necessarily be the guide as to the advisability of financial risk and the investment of capital. Under such circumstances any general principles applicable to the class of phenomena encountered in the territory under examination are of great value and importance.

In the course of the past twenty years, during which I have made many inspections in British Columbia and Alaska and other portions of the Great Northwest, it has become constantly more impressed upon my mind that there is a vast difference in surface appearance, and in mineralization, between southern ore deposits and those that lie within the area formerly covered by the continental ice-sheet, or roughly speaking, north of the fortyfifth or even the fortieth parallel of latitude in Western North America. Recent observations in the mining districts of Sweden have indicated a similar contrast in Europe; not, however, of such great practical importance, because virgin territory here is of limited area, and the mines and mining industry are already hoary with age.

For a proper understanding of my point let me describe briefly the salient features of the region surrounding the Portland Canal. The country is rugged and mountainous, with rocky slopes rising at a steep gradient directly out of the ocean to an elevation of from two thousand to three or four thousand feet. Long winding narrow fjords or inlets extend for many miles into the border, and even into the very heart of the mountains.

For hundreds of miles on the west slope the rocks of the coast belong to the somewhat indefinite 'Vancouver' series of the Canadian Geological Survey. This series contains both sedimentary rocks carrying workable coal seams, and granitic and greenstone eruptives, extrusive as well as intrusive. Although of tremendous thickness and great areal extent it has never been proved to be particularly rich in persistent lodes, in spite of the existence of numerous copper, iron, and lead-silver prospects, with an occasional gold content.

The country is covered with a heavy growth of fir, cedar, spruce, pine, and hemlock. Receiving the precipitation from the moisture-laden winds, which almost constantly move eastward from the Pacific, the snowfall is tremendous for six or seven months in the year, and cold rains are of almost daily occurrence during the summer. The shade of the forest protects the snow from melting, and in many ravines it lies unthawed from one year to the next. The large amount of flowing water produces rapid erosion along the stream-beds, but the retreat of the continental glacier has been so recent that the rocks still present smooth glaciated surfaces. Indeed, many small glaciers still persist, and the air is always chilled by their proximity.

The rocks are fresh, hard, and unoxidized everywhere, both where naturally exposed to observation, and where covered by the heavy forest and moss growing in a thin covering of soil. No soft superficial beds of kaolin or loamy clay, no gossan, nor even iron-stained surface rock, conceal those lying below. A sample of perfectly fresh rock for microscopic examination can often be obtained at a depth of two inches as well as at any greater depth. Fissures and crevices are rare, and few of those that do exist contain vein-mineral or show evidence of the circulation of mineralizing solutions. Indeed, in the course of a journey of 500 miles into the Copper River country I did

not see half a dozen veins with a thickness of more than six inches.

An examination of the sand and gravel in the beds of the streams discloses the presence of an abundance of grains of unoxidized pyrite, with some pyrrhotite, marcasite, chalcopyrite, galena, blende, and other sulphide minerals; and the surface of the country rock is frequently coated with a skin or plating of iron and copper sulphides. In many places the prospector has discovered what he believed to be a mountain of ore, and only reluctantly admitted the truth after driving hundreds of feet of adits and rises in the vain search for the downward extension of the orebodies, which are purely superficial and a result of so much surface concentration as could have been formed under the unfavourable conditions of climate and topography already described and within the few thousand years that have elapsed since the retreat of the last ice-sheet.

In favourable spots, where the rocks are permeable, or most filled by a readily oxidizable combination of minerals and where there is a good chance for the heat of the sun to promote oxidation, there may be at most a few feet of more or less completely desulphidized material, with a consequent enrichment in the case of gold ore or copper ore in limestone. For the most part, however, the sulphide ore outcrops immediately at the surface and is usually not of high grade to any considerable depth.

Now if we contrast the situation just described (and the description holds good for a large portion of the globe in northern latitudes) with the conditions that prevail farther south, we shall, I think, at once begin to appreciate a few of the reasons why so large a proportion of our rich mines are found south of the border of the former glacial mantle.

Starting with a much warmer isothermal and annual average of temperature, we have universally to deal with surface material composed of more or less altered country-rock. In many mining regions this alteration, which may be due to both primary ascending mineralizing solutions and to descending surface waters through unknown ages, is hundreds of feet in depth. Therefore the forces of erosion are operating for the greater part upon altered country-rock and upon the oxidized upper zone of ore deposits, from both of which the soluble constituents have been largely removed and carried downward, perhaps to be re-deposited in richer form below. How extensive this secondary enrichment may be, cannot be ascertained by inspection. Here development is always necessary; in the northern countries it is not. The rocks which have not been planed and scoured by the ice-sheet, and which lie at greater depth are not only softer, but contain a far greater number of fissures and other receptacles favourable to the deposition of ore. Under such conditions we may expect, and usually find, both the rich secondary ore near the bottom of the gossan, and the lower grade primary ore at greater depth.

If we for a moment disregard changes of surface elevation produced by dynamic forces operating over a large territory, and also leave out of the question the erosive action of the last ice-sheet, we can conceive that the depth of rock-decay due to surface-waters would naturally be much less in northern latitudes than in the semi-tropical zones. Other things being equal, we might think of it as increasing from zero thickness in the Arctic regions of perpetual frost to a maximum of perhaps one thousand feet as we approach the equatorial zone. Of course, other things are not equal, and there are many factors of unknown and varying importance in the problem. But, in so far as secondary enrichment by downward leaching is concerned (and for an example of its importance we need only look to Butte, Bingham, Ely, Ray, Bisbee, and Globe) we can at once perceive that since the depth of surface decay is less as we approach the poles and greater in warm latitudes, therefore whatever the destructive effect of the continental ice-sheets, they have not removed and dissipated oxidized ore deposits of the same magnitude as those occurring south of the ice planation.

For a similar reason, when we see the fresh condition of the rocks in British Columbia, and think how deep such freshness lies in Sonora or Oaxaca, we are wrong if we think that ice erosion in Canada must have removed as great a layer of decayed material as now covers much of Mexico. The fact is that, although we do not know how deep glacial erosion may have penetrated, yet the sub-glacial rocks were never so much rotted and weathered as those that have not been glaciated; and chemical activity having been less intense, secondary ore deposition was not so extensive.

It seems a far cry from glacial geology to the genesis of ores and the study of ore deposits; but there cannot be the slightest doubt of their intimate connection. Thus some of the largest soft iron ore beds on the Mesabi range have been partly swept away by the ice-sheet, while others, better protected by a barrier of hard rock, have been preserved.

Summarizing these ideas, thus briefly pre-

sented, we may distinguish between ore deposits in the boreal and temperate zones, as follows :

BOREAL.

1. Boreal regions seldom contain rich and extensive deposits of secondary ore.

2. The surface appearance is often deceptive, and if the ore is high-grade, sudden decrease in value may be expected at limited depth.

3. Where large deposits of *primary ore* are found in glaciated regions, these are likely to extend downward.*

TEMPERATE ZONE.

1. Deep superficial alteration and complete oxidation of vein-matter is a common phenomenon in warm countries and is indicative of good ore below.

2. In general, ore deposits are more abundant in the warm and temperate zones ; and

3. They are not so likely to terminate suddenly or change rapidly in depth.

These remarks as to genesis of ores apply, of course, to veins and deposits of sulphide ores of copper, silver and lead, and, to a less extent, to gold. They do not apply to native copper deposits like those in the Lake Superior region, to iron ore deposits, nor to gold placers, nor to tin mines. They are, however, generally applicable regardless of the peculiarities of local geology ; and although so simple as to be almost axiomatic, and worthy of much more elaboration and emphasis than they have received here, yet are frequently forgotten when the opportunity arises to apply them in practice.

Sulphide Enrichment.

In the September issue of *Economic Geology* we find the following suggestive observations by Charles R. Keyes. They may be read in connection with Mr. Winchell's interesting article.

We now all recognize that it was a great forward step in our knowledge of ore-genesis when Posepny so clearly differentiated the vadose zone from the profound zone; but the main criterion upon which he relied to distinguish in the field the dividing line between ores occurring in the two was far from being valid. A few years later it was found that at the base of the vadose zone, at groundwater-level, oxidized ore-material in solution undergoes marked reduction upon coming in contact with the primary sulphides and that a distinct zone of enriched sulphides is produced. The fact that in some localities secondary enrichment of ore-veins is the result of the reactions of vadose mineral-bearing waters upon unaltered pyrite, has indeed a great practical bearing upon exploitation; but it is not perhaps the only or even the most important of all reactions. In this connection the fact should not be overlooked that another aspect of secondary enrichment of mineral veins at groundwater-level was clearly explained as early as 1873 by T. Sterry Hunt, who ascribed the formation of the bonanza zone to the presence of organic matter. The real significance of Hunt's suggestion has been obscured by the fact that subsequent writers on ore deposits have commonly classed ores of this kind as a distinct type. To an indeterminate extent organic reduction probably always operates in conjunction with reduction of pyrite. What may prove to be the most important of all factors in secondary enrichment is the production of the sulphides by reduction through means of the natural silicates.

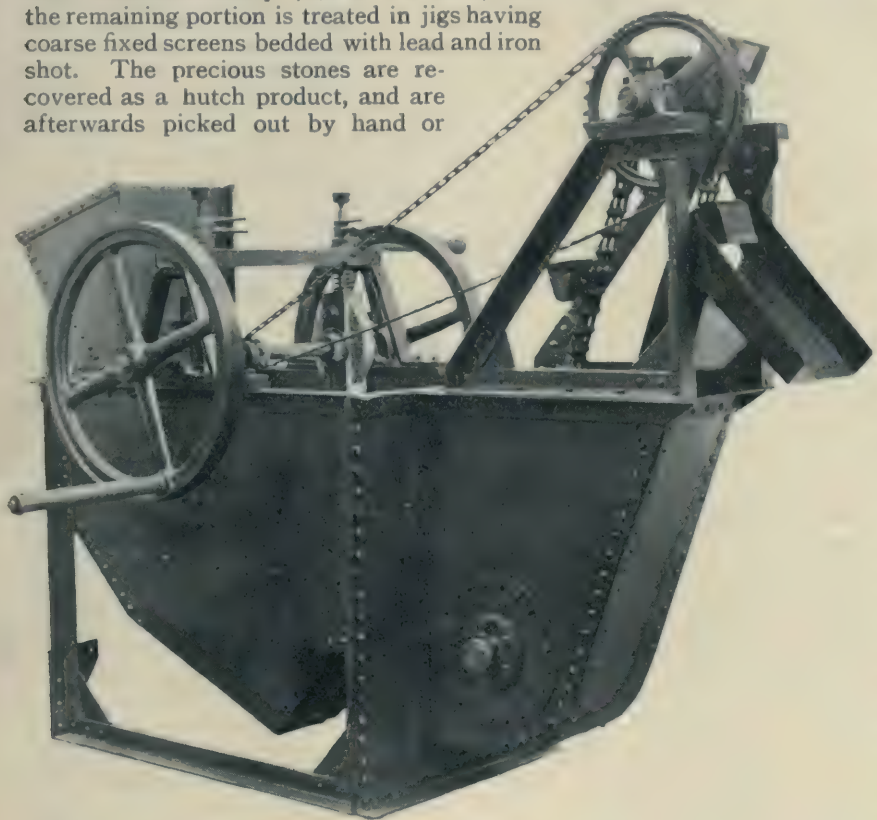
Secondary sulphide enrichment at groundwater-level thus appears to be a universal and not merely a local phenomenon. Since the appearance of the able papers of Weed and of Emmons on the secondary enrichment of the ore deposits of Butte it has become quite the custom in applying their principles to restrict the action to those ore deposits which have direct connection with low-grade veins primarily formed and manifestly filled from the depths. That identically the same principles, chemical conditions, and geologic structures are involved in cases where no lodes previously existed is abundantly demonstrated by such deposits as those of lead and zinc in the Ozarks, by the silver deposits of Lake Valley, New Mexico, and numerous other localities. These facts suggest that so-called secondary enrichment at groundwater-level is a general rather than a special process.

Entirely too much stress seems to be placed upon the importance of the rôle of pyrite in mineral veins as a producer of secondary enrichment. Important as it may be there should not be excluded all other factors involved in the sulphidation of oxidized ore materials. As a matter of fact the phenomenon of secondary enrichment by means of pyrite is, as already intimated, only a single phase of many, and is perhaps not by any means the most vigorous. In most reported cases the alleged reducing action of the pyrite appears to have taken place in conjunction with other deoxidizing influences.

*This statement should be taken to refer strictly to the oxidation of *vein-matter;* for deep alteration of barren country-rock may result in the formation of similar mineral products, but no ore.

DIAMOND-WASHING

LITERATURE relating to the recovery of diamonds and other precious stones from gravel or from clayey matrix is scanty, chiefly because, with the exception of the plant at the big mines in South Africa, no machinery has been used. At these mines the disintegrated earth together with water is passed through pans for the removal of slime and fine sand that constitute nearly 99% of the total, and the remaining portion is treated in jigs having coarse fixed screens bedded with lead and iron shot. The precious stones are recovered as a hutch product, and are afterwards picked out by hand or caught on greasy tables. A plant of this type is only suitable for work on a large scale; the design is of little use to the engineer who wishes to test a gravel or other deposit or to an operator who desires something better than the native pans. In German South West Africa the diamond industry is promising but is still in its infancy. The pioneer companies have adopted jigs based on the principle of the oscillating sieve, on which the diamonds and other heavy stones are deposited. Some of these jigs are adapted for hand labour and others are driven by power, but the notable feature is that they are either mounted on wheels or can be carried on wheeled trucks so as to be easily moved from place to place or follow the particular deposit under treatment. These jigs and the requisite accessory plant have been specially designed by the British Humboldt Engineering Co. and should prove of service to prospectors in other parts of the world. We give an illustration of a jig intended for operation by hand. The sieve is moved by a cam, which causes a rapid downward motion and slow return. The earth, after removal of the slime and fine sand, is shovelled into the hopper shown at the far end and the waste is removed by a small bucket-elevator, which is operated from the driving-shaft. The throw of the sieve can be adjusted according to the size of the material. If the machine is larger or if there are many side-by-side a petrol motor is used for driving, and if the work is on a large scale the trommels, in addition to removing the fine portions, divide the coarser parts into three or four sizes to be treated by different machines. In larger installations each jig is made with two compartments. It is the practice to use salt water in these jigs as its higher specific gravity helps the separation of the diamonds, and the ironwork is given a coat of protective paint. The concentrate is removed usually once every day or two from the sieve, and this is done by the confidential man. The jig is covered at ordinary times so that no one else can gain access to the sieve. The concentrate thus obtained is found in layers of different sizes and in removal from the sieve these sizes are kept separate. A further concentration is done by the confidential man in another jig similar to the hand-jig shown in the illustration.



HAND-JIG FOR DIAMOND WASHING.

GENERAL CONDITIONS IN MEXICO

By THEO. F. VAN WAGENEN.

THE first step toward understanding a nation is to acquire a knowledge of the racial characteristics of the individuals that compose it. The second is to comprehend the geographical, topographical, and climatic features of the land, and its material resources in the way of agricultural and mineral produce. The third is to consider to what extent the people have been influenced by other civilizations. I shall endeavour to take up each of these questions in turn.

At the period of the Spanish conquest the Mexican was an undersized and slimly built individual, with a yellowish-brown skin, scanty beard and fairly quiet disposition. Of course, between the extreme northern and southern boundaries of what is now the Republic there were many variations from this general type. In what is now Sonora, Chihuahua and Coahuila, along the international boundary, the aborigines approached in appearance and characteristics the Apache, Pima, Yuma, and Maricopa tribes of American Indians. They were of fair size, combative, nomadic, and individual. At the southern end of Mexico, now known as the States of Chiapas, Oaxaca, Guerrero, Michoacan, Colima, and Jalisco, the native was almost of tropical type, more nearly a pure savage, cunning, brutal, filthy in person and degraded in habit. Between the two, on the great upland of Central Mexico, was a population that had lost enough of the nomadic and combative characteristics of those in the north to permit of the organization of a system of society under autocratic rule, which is always the first step to civilization. These people, the Aztecs, were well made physically, though of moderate size, brown skinned, fairly well featured, lank of hair, good fighters under the inspiration of loyalty to an individual chief, bloodthirsty and brutal when under the spell of passion or superstition; they possessed little originality or individuality and so were developing with extreme slowness; they were essentially tillers of the soil, and builders to only a moderate degree. Not much is yet known of the races that preceded them, though the country, and especially the southern part, is full of most interesting ruins of older people, who were builders indeed.

Such was the community on which the Spanish conquerors came suddenly, waging a war that led to the subjugation and enslavement of the people. Simultaneously many of the more attractive of the women of the natives fell into the hands of the soldiery, clerics, and officials, resulting in the generation of half-breeds of good physique, but of turbulent and uncertain temperament. This class grew rapidly in numbers as Spanish immigration increased, and as it was in effect a protected class, while the native males were hunted and slaughtered, or enslaved and killed by severe labour in the mines, it became quickly the numerically largest division of the population in all those parts of the country where the Spaniard established himself. When women began to follow the men from Spain into the new world this process of miscegenation was partly checked by the establishment, through the influence of these women, of strong lines of caste, dividing the people into three classes. At the bottom were the enslaved pure natives, and the great bulk of the half and quarter-breeds. The middle class included the remainder of such half-breeds as, by reason of fortunate environment, physical attractiveness or mental ability, were able to float above the lowest class. Uppermost were the pure whites. As the intermingling of races proceeded, and the parents of the first and second generations of half-breeds died, the latter lost their protectors. Since then the social history of the country may be said to have been an effort on the part of the whites to relegate the majority of the half-breeds to the position of the native, coupled with the desperate efforts of those of mixed blood to retain their standing, and to raise themselves whenever possible.

The outcome of such a contest is always the same when not complicated by the influx of new elements from outside sources. For quite 200 years the Mexicans have been left to themselves to work out this racial problem. The pure whites being at first the principal owners of land and mines, became wealthy and luxurious, and while their women refused to mingle their blood with that of the half-breeds, the men had no such scruples. Hence the mixed population increased in number rapidly, and with each new generation presented on the whole a closer approximation to the aborigines. At the present time the process has about reached its limit. The great middle class has

won the racial victory, as was inevitable. The pure white has been almost completely absorbed. The country is now in the possession of two classes, instead of three: the 'peon' and the 'Mexican.' The latter has arrived.

A Beggar.

He is of all shades, from pale olive to a pleasing brown. Of average stature but slimly built, dark haired and moderately bearded, well featured, though with a tendency to full lips, intellectually bright and capable but lacking in initiative, not energetic unless deeply roused, not strongly individual, but rather contemplative and contented with things as they are. It is a race foredoomed to absorption or extinction, because so largely built up from below; yet a race that if left alone could and would rise to the level of the average human type. It is not, however, the way of nature for any race to be left to itself permanently. Sooner or later the 'outlander' appears and all the rules of the game are changed.

As for the peon, whether of the Yaqui, the Aztec, or the Tehuantepec strain, though carrying a notable percentage of white blood, he is little better than the original native, unclean, unattractive physically, lazy, without ambition or initiative, but mentally bright and capable of being trained if his natural indolence were overcome.

Before leaving this branch of the subject it should be said that there is no such gulf, racial or social, between the Mexican and the peon as there is between the Caucasian and the Negro in Africa and elsewhere, or the English and Hindoo in India. The Mexican seems to recognize the fact that he is of a mixed race, he is by no means ashamed of his strain of Indian blood, and, having little love for his former Spanish ruler, is not proud of his Iberian descent. Altogether a healthy and normal view of the race question exists. The peon may, and does, rise into the class above him. There is no effort to keep him down.

A Water-Seller.

The minute he exhibits cleanliness, discards his rags and gives evidence of intellectual advance, he is permitted to climb socially, no matter how dark his complexion. On this account there are found among the upper classes individuals of distinct Indian physiognomy and

colour, and who, as a matter of fact, have but a small amount of Caucasian blood in their veins.

In brief, the chief historical events in the life of Mexico may be summarized as follows:

(1) Conquest by Spain, completed in 1521.

(2) Settlement and immigration. The country was parcelled out by Spain in the form of vast agricultural, pastoral and mineral grants among the *conquistadores*, their friends, followers, and descendants, and to favoured Spanish officials and nobles. Also the period in which the great mines were discovered and worked most vigorously, and during which the intermingling of the two races occurred—1521 to 1770.

(3) Era of depression, due to the supposed exhaustion of many of the mines, and the neglect or harsh treatment of the colony by Spain. The population became restive, dissatisfied, and finally openly rebellious—1770 to 1810.

(4) Successful struggle for independence—1810 to 1821.

(5) Revolutionary wars. In this period the contest for supremacy between the pure natives and half-breeds on the one side, and the pure whites on the other, was at its height, and terminated in the election of Juarez (a full-blooded Indian) to the Presidency in 1867. Within this half-century occurred the secession of Texas from the Confederacy (1836), a small war with France (1838), the war with the United States (1846–'47), the proclamation of the Federal Constitution (1857), and the French intervention (1861–'67). Throughout it looked to the superficial observer as if the Mexicans were quite unfit for self-government, and that they should have been taken under the protection of some strong power. The French intervention was based upon this idea. But it failed ignominiously, and the world has been given an example of the way in which a feeble nationality, with apparently inferior racial advantages, will work out its own salvation and acquire the art of self-control, if left to itself—1821–1867.

(6) Second revolutionary era. A continuation of the last, resulting finally in the election of Porfirio Diaz (a three-quarters Indian) to the position of Chief Executive. During this period Church and State were (1873) finally and completely separated, all Church property being confiscated to the State—1867 to 1877.

(7) Peace and development—1877 to present date.

In this period of nearly four centuries Mexico has had but two real wars with foreign people; with the United States in 1846 and with France from 1861 to 1867. The first was but a mimic contest, for the nation was a child at the time, unarmed, untrained, and disunited. It was, however, quite unable to act as custodian of the enormous northern territories that were ceded at the end of the war, and they were justly lost, though not justly won by the United States. There is no doubt that if the war had not occurred, the Pacific and Mountain States now carved out of former Mexican territory would have been over-run by Americans after the discovery of gold in California, in 1848, and the whole vast region would have been annexed, as Texas was. The Mexican war may be considered as having accomplished in two short campaigns what would have inevitably taken place, but might have required a dozen years of desultory fighting or diplomacy. The second war brought into the land a few thousand Frenchmen, many of whom remained and became citizens. But the Frenchman is a Latin. He was absorbed naturally and rapidly, and has left no marked trace on the people but his names.

Mexico has the ocean on both sides of it, but it is the tropical ocean, and so this situation has not resulted in the production of a maritime people. It may safely be assumed that the nation will never become a naval power. It has not the timber for shipbuilding near its shores. It will always lack the individual commercial aggressiveness that is at the basis of a sea-borne trade. Its coastal regions are everywhere *tierras calientes*. Lassitude prevails. Initiative is totally lacking. No one lives by choice in either its Atlantic or Pacific ports. They are perennially unhealthy and uncomfortable, and always will be, except for so brief a period in the winter as to be ineffective in altering the general status.

On the other hand, the interior is a vast upland with a climate that is generally superb, that should and would breed a race of great energy and capacity, other conditions being equally favourable. But on this great plateau the rainfall is either deficient or excessive. So short is the distance to the sea on either side, and so abrupt the fall from the upland to the lowland, that navigable streams are unknown. The people of the interior are consequently brought but slightly into relations with those of the coast. Millions of them have no conception of water-transport. For centuries goods of all kinds have been moved on the backs of animals and human beings, and the transition from these systems to that of the railroad has

GUANAJUATO.

COLIMA.

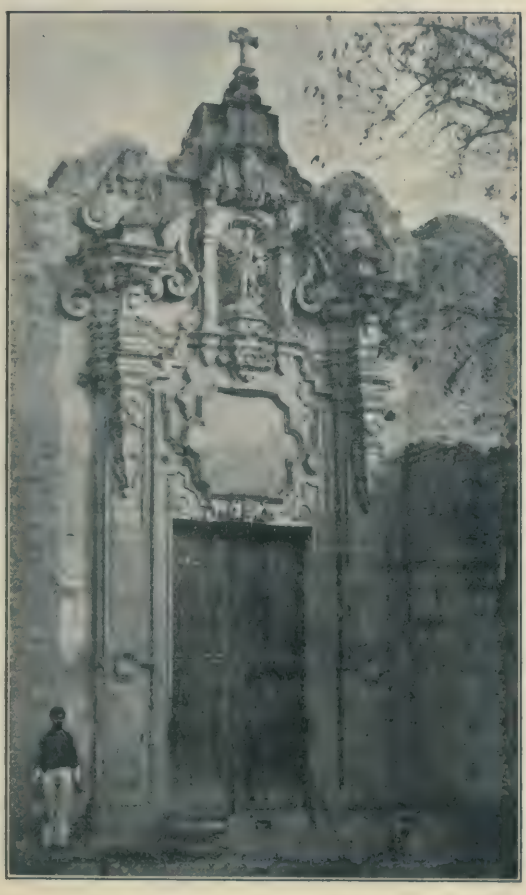
been so sudden that the use of wheeled vehicles is practically unknown outside of the larger towns.

These same geographical, topographical, and climatic features produce a country that is for the most part arid or semi-arid. The torrential nature of the rainfall causes the streams to rush in deep canyons, or to be notably intermittent, both circumstances hindering the use of much of the water for irrigation purposes in the uplands until capital is expended for the construction of reservoirs for the preservation of the surplus precipitation. All this means that for some time Mexico cannot hope to be a large producer of breadstuffs, or even of cotton, though it has plenty of land that will yield both if sufficiently watered, and a favourable climate. Individual farming, however is not a fashionable or even a respectable occupation with the upper classes, and is largely relegated to the peons, who cultivate the ground miserably. In spots, as in parts of Queretaro, Oaxaca, and Jalisco, the conditions are more favourable and some large and prosperous farms exist, yet the general sentiment of the educated and well to do people is that agriculture is an occupation not honourable enough to warrant the serious attention of men of any capacity. Even when such men do take it up the details are left to the ignorant and shiftless peon, and everything is badly done. Thus do environment and natural physical conditions form the character of a people. Each industry arises out of, and as a consequence of, the actual physical peculiarities of the country itself, and, reacting upon the populace, produces a race with marked peculiarites, which, no matter what might be their inherent ethnological characteristics, will be different from those developed by the same race when living under other conditions. Take, for example, the mining and manufacturing industries. Mexico is a land of wonderful mineral resources, largely of the precious metals (gold and silver) and of those base metals (copper, lead, zinc, quicksilver, and tin) that are so greatly in demand at this period of the world's history. Plenty of iron exists, but a deficiency in coal, which means lack of power. On the other hand, the country is liberally provided with streams travelling seaward on a steep gradient, many of which are capable of being harnessed so as to yield electrical energy.

In the past the mining occupation has been regarded by the Mexicans as hazardous. In fact, it is so regarded at the present time, though with us, as science and close business methods have been introduced, much of its uncertainty has disappeared. But a hazardous occupation requires for its development a people of optimistic temperament, and, reacting, it produces a population of that kind. Translated into commonplace terms, we say that such a people are 'natural gamblers.' We credit the Spaniard with an excess of these tendencies, and quite naturally, for the Iberian peninsula has been for forty centuries a wonderful mining region. The Spanish blood diffused through Mexico at the Conquest, and subsequently, carried with it a strong infusion of the gambling spirit, and when the precious-metal mines were discovered, from 1522 to 1540, the national temperament displayed itself. But there are gamblers and gamblers. There is the petty gambler and the grand gambler, the man who will take small chances with his money in lottery tickets, card games, or small business ventures, where the amount involved is slight but where the investment is made consciously on the basis of pure chance, and the larger operator, the more cold-blooded and calculating man, who puts his mind into the operation, tries to ascertain cause and effect, and endeavours to force the chance his way. The Spaniard and his Mexican descendant belong to the first class: they may be called casual gamblers. The colder Anglo-Saxon and Teuton are in the second, and are constructive gamblers. The Spanish mines were always improvidently worked, without regard for the future. Immediate profit was the aim. As a result the industry in Spain is not as a whole creditable to the age. The Mexican mines have been handled like those of Spain. Few were sunk to depths of over 500 ft. At first the rich surface ores yielded wonderfully because they could be obtained and treated easily. But at depths ranging from 300 to 500 ft. operations ceased almost everywhere, even if water was not found in excess. Go where one would from the Rio Grande to the Isthmus, only mining wrecks could be found prior to the last period of the life of the Republic. The Mexican is not a miner, either by temperament or by virtue of any natural capacity, and today, when so many of the best mineral deposits of the country have already passed out of his possession, and so many more are on the road to foreign ownership, he stands listlessly, regretting the course of events, jealous of the enormous profits the foreigner is making, but unwilling to risk his own money in the business.

Lacking coal, Mexico cannot become a manufacturing country until its abundant water-powers are developed. This will not be done by native capitalists, but by the foreigner, and as it is done, these powers, so valuable and so

AN ALTAR IN THE PEREGRINA MINE.



The gateway of the Rayas Mine.

completely the key to the future of the country, will pass to the possession of the alien.

There remain two other natural resources: pasture land and forest. Both are extensive. In the northern States—Chihuahua, Coahuila, and Durango—and in the Central States—Jalisco, Zacatecas, and San Luis Potosi—there are enormous areas admirably suited for breeding cattle. And in the higher parts of the western and southern edge of the great plateau of Mexico, corresponding to a continuation of the Rocky Mountains, there are vast virgin forests of pine, spruce, and oak. The Mexican has developed a cattle industry, but the animals are small from centuries of in-breeding, and the meat is juiceless because no effort has been made to improve the range with watering places, or to provide fodder to carry the animals comfortably through the dry season. Cattle-farming performed in a grand way, with no regard for details, and no effort to improve on natural conditions, has been considered a reputable and honourable occupation, but mainly because it took care of itself, or would do so after a fashion. As for the forests with which his country is so well supplied, the Mexican has done nothing. He builds of stone and sun-dried brick, and builds well, though in a most monotonous style.

One other influence has been strong, and has had much to do with forming the national character: the Church. The entire population of the Republic belong nominally to the Roman Church. Upon the peon class it has reacted as a pure superstition, with nothing of reason,

sentiment, or intellectuality to differentiate it from the superstitions of their heathen ancestors. To them the priest is the representative not only of the Deity, but of the Devil, and he must be supported, placated, obeyed, and reverenced as one who can not only pass the individual safely into paradise, but as quickly and as willingly, if offended, would consign him to purgatory. It is questionable whether any branch of the Latin race hold these two views of the aims of religion as strongly as the Mexican peon. In the upper classes the women still cling to the Church as they do in France, Spain, and Italy, and the men have done the same until recently, though not from motives so simple. Now they are breaking away, not openly, but actually, and nothing is taking the place of the Church. It has always been a painful process to cut loose from authority. It requires moral courage of the highest order. It requires individuality. All communities that have done so have developed higher qualities. Church and State have been separated in Mexico since 1873, but the effects of the legal dominance of the former for more than three centuries before that time, coupled with its actual later dominance over the ignorant and unthinking, cannot be dissipated for many years, and will leave its impress on the moral character of all but the most advanced and intelligent for an indefinite period. One of the most marked of these is a tendency to cluster around the visible expression of the creed, the parish church and the city cathedral. This means the collection of the bulk of the people into towns. In its turn this produces at first a dislike for country life, followed by sentiments more or less contemptuous for those who choose or are compelled to adopt such a residence, ending in a contempt for the occupation (agriculture) that they follow. All these processes have been passed through in the formation of the Mexican nationality. Of the twelve million people who now compose it, fully a quarter live in cities and towns large enough to support a church of some pretensions, while most of the great *haciendas* (farms) that were such a feature of the country prior to the days of the railroad are nearly deserted by all but the very old among the upper classes. Numbers of these estates are yearly passing away from the ownership of the Mexican farmer, who must sell to provide the means for maintaining his family in the expensive city, and the rising generation of this fine class, who in many respects can be fitly compared to the 'planter' class in the Southern States of America in ante-bellum days, are now largely engaged in the pleasing but demoralizing job of dissipating their patrimony.

Thus the Mexican of today: About ten million peons, unclean, unambitious, lazy, densely ignorant, incapable of mental effort except of the most rudimentary kind, docile yet unreliable, superstitious to a degree, and wholly under the influence of the Church, gentle, faithful, and worthy in family relations, but petty thieves and choice liars to the rest of the world, and given much to intoxication in a mild form. About two million of the better class, well featured, intellectually bright but inert, temperate, yet a little gross in habit among the wealthy, without initiative or invention, with little energy, courteous, and honest, yet shrewd in money matters, but not in the least enterprising, rather jealous but with no capacity to seize opportunity as presented, and with as yet but little of the moral courage and individuality that must come before he can hold his own against the strong tide of Anglo-Saxondom that is sweeping down upon him from the north.

Few coming events are more certain than that the conditions that caused the gravitation of Texas into the United States in 1838 are being repeated now, but in a slightly different form, in the border states of Sonora, Chihuahua and Coahuila, and will spread through them southward until the whole of Mexico is infected. Already it is claimed by some that half of the population of Chihuahua is alien, and if the peon class be excluded the statement can undoubtedly be substantiated. In Sonora the population of foreigners is nearly as large. The time is coming fast when the intelligent people of these States, desiring the advantages of local self-government and the opportunity to participate in the game of politics, are certain to begin an agitation looking first to secession, and then to admission into the United States. What has been above written may not come amiss in drawing attention to the character of the people and their capacity for citizenship, as we understand that term. It is one thing for the United States to receive foreigners by the hundreds of thousands annually at the Atlantic seaboard and absorb, assimilate, and digest them by a process of engulfment in a new environment. It is entirely different, to attempt in Mexico, to make citizens of a population by the process of acquiring control of the land they live in, and gradually surrounding them with new ideas, customs and ways of life. The problem is serious; it cannot be avoided. On the solution of it depends the future of Mexico.

OILFIELDS OF SAKHALIN

By CONSTANTINE E. PFAFFIUS.

THE enormous development recorded during the last 50 years in nearly every branch of industry has emphasized the problem of maintaining an adequate supply of fuel in manufacturing, mining, shipping, and naval spheres of activity. Among the better known combustibles, liquid fuel is steadily gaining in popularity and application, owing to the many advantages it possesses over coal and other solid fuels in the matter of ease of handling, cleanliness, and high calorific value. Last, but not least, crude oil, even under present antiquated methods of treatment, yields such a number of valuable by-products (lubricating oils, illuminating oils, and benzine, the demand for which is steadily increasing) that the prospector is always on the look-out for new sources of supply. The older oilfields of South Russia and the United States, until recently the principal sources of the world's petroleum supply, have for some time been exhibiting signs of approaching exhaustion, although California is rapidly coming to the front and the Galician, Roumanian, Asiatic and other oilfields of minor importance are steadily advancing in output.

The possibilities of Sakhalin, as a prolific and reliable source of oil, have recently attracted attention. Situated between 142° and 145° east longitude and, roughly, extending from 40° to 54° 20′ north latitude, the island has approximately a length of 600 miles and a width of from 100 miles at its widest to 10 miles at its narrowest part. The parallel of 50° north latitude practically bisects the island into two more or less equal parts, Russian and Japanese, respectively.

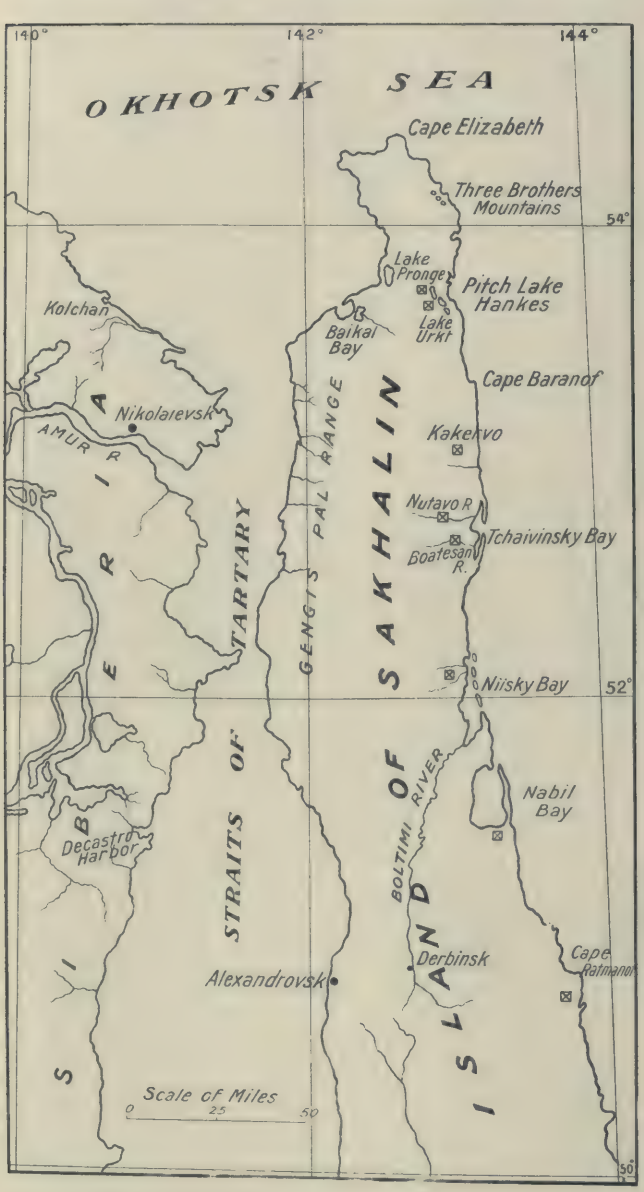
The northeastern part of the Russian portion of the island is alleged to contain one of the most extensive and reliable oil-belts in existence. The surface exposures consist of Tertiary sandstone, but it has been proved by borings that older rocks lie beneath. Surface evidence of the existence of an oil horizon at depth is provided all along the Pacific coast, commencing at Nabil Bay and extending to the northern extremity of the island—a distance of nearly 200 miles—and from 6 to 12 miles inland, by a succession of lakes, seepages, sand hillocks, and plains the ground of which is saturated with oil. The oil is to some extent drained seaward by the numerous creeks and lagoons, but most of it evaporates on exposure to atmospheric influences and when mixed with grains of sand forms what is known in Russia as *keer*, a product resembling semi-solid asphalt.

The honour of having been the pioneers of the petroleum industry in Sakhalin is due to Messrs. Zotov and Kleye. However, they do not appear to have been particularly enterprising, nor to have had much financial backing. As yet they have not obtained any important results, although they have been drilling during a period of fully ten years. Claims have been staked by scores of other Russians, but these have done practically nothing in the sense of testing the ground, their sole aim being to hold their concessions until someone else succeeds in bringing in a gusher and then to dispose of their rights. The Russian government has stopped this indiscriminate claim-staking and now no one may be granted a concession to more than two plots of 100 acres each for prospecting purposes, and this right is subject to the locator sinking within the period of two years from the grant of the concession at least one well of a minimum depth of 600 ft., unless the oil-bed be struck at a shallower depth, on each claim. In the event of non-compliance with this stipulation the concessionaire forfeits his rights and the 'perimeter' (claim) is confiscated.

The establishment of a properly equipped petroleum industry on the island has been hindered by the prevalence during the greater part of the year of severe weather, such as a temperature of 20° to 40° F. below zero for 5 months, heavy snow-falls, and blizzards. These being the conditions, the capital outlay on buildings, workshops, material, tools, spares, provisions, and other equipment, practically excludes the small producer as a factor of any importance whatsoever in so far as the establishment of a petroleum enterprise in this part of the world is concerned. On the other hand, a financially sound enterprise would find here almost unlimited scope for extension.

Mr. C. W. Purington has kindly furnished the following additional data: The most practical point for attacking the oilfields is Baikal

Bay, on the northwest coast. This is a good harbour with a depth of from 24 to 36 ft., almost land-locked, in Lat. 53° 30′, and fully open to navigation during August and September of each year. A pipe-line from the shore of Baikal Bay to the pitch lake of Hankes would not exceed 30 miles in length. The island is heavily timbered, well watered, and it has other natural resources of considerable importance. The fish-canners of Nikolaievsk maintain considerable establishments during the season both at Baikal Bay and at Lake Prongé. Small tugs and gasolene schooners ply back and forth between Lake Prongé and Nikolaievsk, a distance of about 100 miles. Japanese and Chinese labour is abundant. Owing to the lack of regular communication and the nearly uninhabited character of the region, the cost of an outfit delivered may be reckoned at three times what it is in California, while the cost of drilling will be five to six times as high. Up to the present the wells that have been drilled to 600 ft. have been unsuccessful, but indications point to the possibility that deep wells may tap reservoirs of valuable oil.



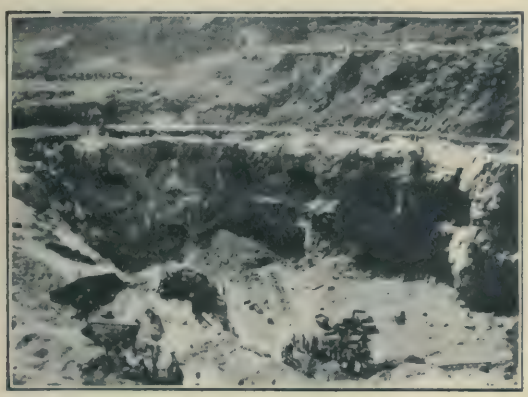
Sakhalin Oil Deposits.

Further information about the petroleum resources of Sakhalin is given by Mr. D. A. Louis in a report describing his examination of properties made on behalf of Mr. Paul Dvorkowitz. These properties are situated on the rivers Boatesan and Nutavo which drain into Tchaivinsky bay. The former was originally discovered by Mr. Kleye as mentioned in the above article. The petroleum is found in pitch lakes in the midst of peaty swamps. The lakes are covered with a black crust and prospecting holes were dug through it at a number of places for the purpose of taking samples of the oil below. The oil thus collected is heavy and of high flash point; it contains practically none of the lighter spirit, which has presumably been evaporated long ago. On the other hand the oil contains no solid carbon and there is no asphalte associated with it, so that it may be considered a naturally filtered oil. In fact the oil closely resembles that found in Borneo, and, arguing by analogy, Mr. Dvorkowitz is of opinion that the deposits will develop in the same satisfactory way. It will be seen that Mr. Dvorkowitz and Mr. Pfaffius do not agree as regards the presence of asphalte. The route for approaching this district is by steamer from Vladivostok to Alexandrovsk and then by government post road down the Bostimi or Tym valley.

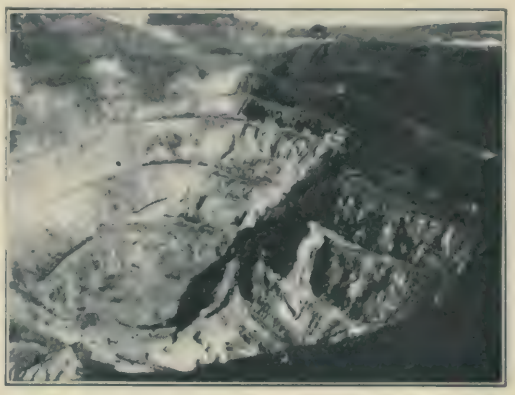
PRÉCIS OF TECHNOLOGY

Secondary Enrichment at Huelva.—A paper on secondary enrichment in the copper deposits of Huelva was read by A. M. Finlayson at the November meeting of the Institution of Mining and Metallurgy. Those who have not already seen Mr. Finlayson's paper on the Huelva deposits published in a recent issue of *Economic Geology* may be recommended to study it concurrently with the present paper. The author considers the Huelva deposits to be the most striking instance of the importance of secondary processes, for without them the primary ore would have been too lean to be of value for its copper content. There is no doubt that the rich secondary ore immediately under the gossan was the object of Roman operations. At the present time the average copper content at Rio Tinto is 2·26% and of that of the primary ore alone 1½%. As the workings go down, the content of the secondary and then of the primary ore gradually decreases until in many cases the ore is mined solely for its sulphur content. The decline is partly due to secondary causes and is partly a characteristic of the primary ore, and the limits of these phases have to be carefully investigated. The orebodies were probably formed at the last stage of the series of earth movement and igneous intrusions during Permo-Carboniferous times. They were, when formed, at a considerable distance below the surface, and their existence would never have been known but for the extensive erosion which has taken place. An idea of the amount of erosion can be obtained by examining the ferruginous conglomerate capping at various places. These deposits are essentially bog-iron ore formed in Miocene time by deposition from streams draining from the former outcrops of the lodes. The deposit is only found in a few places and the remainder of it has been removed by the streams that have formed the present valleys. As regards the alteration and erosion of the orebodies, the chemical processes of cementation have proceeded faster than the physical processes of denudation. The rainfall (25 in. per year) has been sufficient to ensure deep alteration but insufficient to cause rapid erosion in a country of gentle slopes and smooth surfaces. Thus all the factors in recent time favour deep enrichment. The bulk of the enriched ore carries chalcopyrite, and this ore is yellower and softer than the typical primary ore. Chalcocite is abundant both in the ore itself and in cracks and joints in the lodes and adjoining country rock. Other sulphides are found in small quantities here and there, such as bornite, tetrahedite, galena, and blende, also native copper. Oxidized copper ores are scarce, a fact evidently due to the reducing influence of the pyrite. A tendency to enrichment on the foot-wall is noticeable in some cases. As a rule the zone of enrichment goes down to 200 or 250 ft. below the gossan, but in many instances it is much deeper; for instance at Sotiel, a seam of secondary chalcopyrite and chalcocite follows a fissure close to the foot-wall of a lean orebody down to 630 ft. The depth of enrichment depends on many factors such as the depth of the overlying gossan and the amount of denudation.

The author describes the results of microscopic examination. The processes of secondary enrichment, as seen under the microscope, are of two types. There is, on the one hand, a direct change from chalcopyrite to chalcocite, with progressive aggregation of chalcocite; and on the other hand a progressive deposition and concentration of chalcopyrite, accompanied by replacement of pyrite, and a subordinate development of chalcocite. In the first case, the chalcocite appears as a selvage to the granules of chalcopyrite, or as an alteration-product of branching strings of the latter mineral. It gradually increases till it encloses only a residual core of chalcopyrite, which finally disappears. The grains of chalcocite thus formed become centres of aggregation, larger masses of mineral gradually forming by replacement of the surrounding pyrite, and spreading through the ore along cracks, joints, and minute solution-cavities. In the second type of enrichment, there is a gradual increase of chalcopyrite by deposition of secondary mineral around a nucleus of primary grains. Masses of interlacing strings are thus formed, which gradually replace the pyrite, and finally form bunches of compact chalcopyrite scattered through the ore. Here the formation of chalcocite does not generally commence till a late stage in the alteration, when it goes on as before, appearing first round the borders of the chalcopyrite, and spreading into it along cracks. Bornite occurs in subordinate quantity in both types of alteration, generally as thin strings traversing the ore adjoining the other copper minerals. These two processes of alteration naturally graduate one into the other to a variable extent. Generally, however, it appears that the direct formasion of chalcocite is characteristic of lean ores, and



Contact of Gossan and Sulphide, Rio Tinto.



Large Open-cut, Rio Tinto.

often occurs at considerable depth. On the other hand, the formation of secondary chalcopyrite was observed generally in richer primary ores.

The author's general conclusions are that the copper occurs primarily as a definite mineral, chalcopyrite, and is not chemically combined with the pyrite; that the processes of secondary enrichment consist in lean ores of a change from chalcopyrite to chalcocite, and in richer ores (1½ to 2%) of a gradual aggregation of secondary chalcopyrite accompanied by chalcocite; and that the changes due to enrichment extend to considerably greater depths than is indicated by the percentage composition of the ore.

The author concludes his paper by a comparison of the reactions that take place during the leaching process with those occurring in the progress of natural secondary enrichment. In leaching the chalcocite is removed more rapidly than the chalcopyrite and during the weathering the chalcopyrite is gradually transformed into the more soluble chalcocite. He quotes C. H. Jones, who, in a paper read before the American Institute in 1904, assumed that the copper in the ore is in the form of chalcocite for the reason that this compound is more readily soluble, and he shows that Mr. Jones' supposition is not necessarily correct, because according to his own observation the chalcocite is formed during the process of weathering.

Mount Morgan Ore Deposit.—At the November meeting of the Institution of Mining and Metallurgy, J. Bowie Wilson presented a paper discussing the origin of the ore deposit at Mount Morgan, Queensland. He reviewed the previous theories put forward by R. L. Jack, J. M. Cameron, and T. A. Rickard, all of whom examined the deposit years ago when its characteristics were not fully known. In spite of the lack of data, the last named, in the present author's opinion, came very near the explanation warranted by the fuller information now available. As we gave a full abstract in our September issue of an article by J. M. Newman and G. T. Campbell Brown on the same subject, read before the Australasian Institute of Mining Engineers, we need not here repeat the description of the geology of the district or of the nature of the orebodies and we give only Mr. Wilson's hypothesis of the genesis of the ore. He considers the deposit to have been formed by ascending mineral solutions, circulating through fissures caused by the fracturing action of intrusive dikes. The mineralization has occurred simultaneously with the metamorphism of the original sedimentary rocks. It is impossible to account for so great an orebody by lateral secretion or by the introduction of the metals by the intrusive dikes. There are many points in connection with this theory upon which the author invites discussion, as he has not been able to explain them in a manner satisfactory to himself. The first is the sharp separation between the orebody and the country rock seen in the northeast side of the deposit. His theory would presuppose a more gradual transition of the orebody into country rock. The second is the irregularity of the gold content, and the third is the sudden appearance of high-grade copper ore to the west of the andesite dike at the 650 ft. level.

The discussion on Mr. Wilson's paper was of unusual interest, and in all probability many contributions will be submitted later by correspondence. As Mr. Wilson quoted T. A. Rickard's views, expressed in 1890, a contribution to the discussion by the latter is of special interest. Mr. Rickard found that a country of highly altered sedimentary rocks had been penetrated by eruptive dikes, and at one place, particularly affected by plutonic intrusions, a mass of gold-bearing silicious ore was formed. Of the sedimentary series, the topmost, called the Desert sandstone, has been eroded at the Mount, but it forms cliffs on the neighbouring ridges. Under the sandstone comes greywacke, and under the greywacke lies quartzite. In the mine he saw the quartzite under the silicious ore and suggested that the ore was a replacement in the greywacke. Subsequent reports contained references to the finding of patches of greywacke in the stopes and he accepted this as a confirmation of his original suggestion. He believed that the oxidized ore lay upon the quartzite and under the sandstone. Mr. Wilson states that the Mount was originally capped by sandstone, and that he found blocks of sandstone in the old waste heaps. This is most interesting, and confirmatory of Mr. Rickard's view.

With regard to the so-called silicious sinter of Mount Morgan, the vesicular quartz found there is the silicious skeleton left from the corrosive action of acid waters on a partly soluble rock. Mr. Wilson draws attention to the fact that the edges of the cavities are neither rounded nor botryoidal. It is exceedingly light, owing to the air spaces. Such quartz was found in large masses at Mount Morgan, but it has been found both before and since in other deposits that have been the sport of the chemical action induced by underground waters rich in the sulphuric acid formed by the oxidation of pyrite. Under such conditions it is not difficult to understand how the dikes that penetrated the quartzite and greywacke were so decomposed as to be unrecognizable. Both R. L. Jack and J. M. Cameron believed that the dikes were intruded after the ore had been deposited because they were unable to see the dikes traversing the ore. On the contrary, although decomposed almost past recognition, the dikes do penetrate the orebody, in the formation of which they played a necessary part. Mr. Wilson's explanation, in brief, is that Mount Morgan as a mine consists of an oxidized deposit resting on a large pyritic body of ore. In other words, the pyritic quartzite is the continuation of the big gossan.

Mr. Rickard then proceeded to give his matured view of the origin of the deposit. It is agreed that there is a sudden transition from the sulphide ore to the oxidized material, and that the sulphide ore is in quartzite, and it has been proved that the gossan is a replacement of greywacke; thus he comes to the conclusion that his original theory holds good with a modification, namely, that this huge ore deposit traverses both the greywacke and the quartzite in a locus rendered favourable to the play of mineral solutions by the penetration of a group of dikes, which first shattered the rock and then afforded a passage for the circulation of the thermal waters that are the sequel to igneous activity. The sudden transition between the pyritic ore and the big cap of gossan would then be explained as coinciding with the change from quartzite to greywacke, the latter, owing to its felspathic constituent, being far more vulnerable to the corrosive action of the acid waters formed by the oxidation of the pyrite.

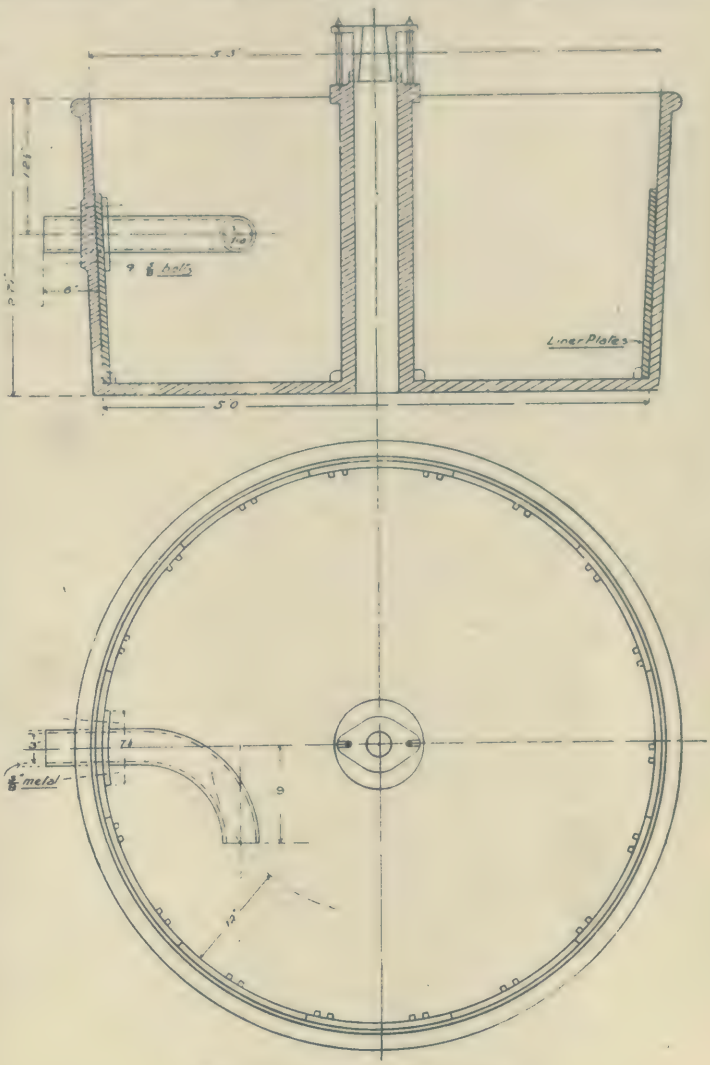
In the case of Mount Morgan, as in that of other celebrated ore deposits, there is great confusion in regard to the nomenclature of the prevailing rocks. The petrology is further complicated by disagreement as to the nature of the rocks enclosing the ore and replaced by the ore. Hitherto the sedimentary, although metamorphosed, character of the formation has been accepted, but lately in a paper read before the Australasian Institute of Mining Engineers it has been suggested, if not insisted, that the Mount consists of quartz-porphyry and felsite, not greywacke and quart-

zite, although it is allowed that they resemble silicified tuffs and breccias, and that they contain at least three scattered masses of crystalline limestone. It is a nice question at what stage a sedimentary rock by metamorphism becomes crystalline, and even if the microscope can determine that it is now crystalline, it remains uncertain what it was originally. For example, greywacke is a rock formed from the disintegration of granite, and consists of quartz and felspar granules bound in an argillaceous cement. Thus the quartz and felspar of the granite help to reform a clastic rock. The mica has been removed in the course of erosion. If it survives, an arkose is formed. When greywacke undergoes metamorphism it may become crystallized to felsite or even quartz-porphyry.

Grinding-Pan Discharge.—In the *Monthly Journal* of the Chamber of Mines of Western Australia, G. C. Klug describes a new method of regulating the classification of the discharge of grinding pans. The system was invented by C. C. Freeman and it has been in use at the Great Fingall mine for over a year. At this mine the ore is first crushed by stamp-mills to 8 or 10 mesh and is then ground in pans of the wheeler type, 5ft. in diameter. In place of the ordinary spitzkasten discharge Mr. Freeman has introduced a method depending on the classifying action of centrifugal force. A discharge pipe 3 in. diam., with a bend, is fitted into the pan at the opposite side of the feed The speed of the mullers is about 60 revolutions per minute, which is sufficient to bring the *minus* 30 product to the discharge pipe. It is found that the particles when crushed fine enough are immediately removed and cannot again come between the shoes and dies. The discharge requires absolutely no attention. As regards efficiency it is found that, though with ordinary classifiers from 10 to 15% of *plus* 30 went over with the discharge, with the Freeman classifier the amount of coarse material going over is only 4 to 6%. At the same time the battery screens have been made coarser, the mesh being reduced from 8 or 10 to 7 holes per linear inch. The stamp duty has been increased from 7½ to 9·2 tons per day. A pan with the Freeman discharge will easily handle the product of 5 stamps. Mr. Klug in his paper gives tabulated results of the efficiency of the grinding pans.

Flotation.—The *Australian Mining Standard* for September 28 publishes some details relating to the flotation process employed by the Minerals Separation company. Henry Lavers, one of the engineers, has discovered that oil prepared from the eucalyptus tree is highly efficient in frothing and agglomerating the sulphide particles, and this oil has now superseded petroleum, spirit oils, and the like. As the eucalyptus tree is plentiful locally, the oil can be obtained cheaply. A very small quantity is required and the cost of it is less than threepence per ton of ore treated. When it is employed, the amount of sulphuric acid can be greatly reduced; in fact with copper ores it may be entirely omitted.

Mineral Deposits in Uruguay.—C. Guillemain in *Zeitschrift fur Praktische Geologie* for September gives an account of an investigation which he has recently made into the geology of Uruguay. He found in various parts of the country deposits of gold which were associated with quartz veins penetrating schists and diorite. The deposits at Minas, in the Minas province, and those at Zapucay, in the Rivera province, occur in shattered amphibolite and chlorite schist. At Minas, this schist is traversed by quartz veins which, in addition to pyrite and chalcopyrite, usually contained free gold. These deposits, up to now, have not been worked. In the Rivera province, free gold is found in considerable quantities in quartz lying along the line of deposit of slate and also along the bedding



Freeman's Discharge for Grinding-Pans.

of the adjacent chlorite schists. At Zapucay, mining has been done, but operations were discontinued some years ago, either in consequence of the revolutions or possibly by reason of the difficulty of obtaining the necessary capital and trustworthy officials. Some gold is obtained by the natives in a primitive way. Not far distant, at Corales, an auriferous diorite, containing considerable quantities of pyrite is found; in this case the free gold is scarce, but the pyrite contains enough gold to warrant the erection of stamps by a French company in Cuniapiru. These workings constitute the only mine in actual operation in the republic. Free gold is also found in the diorite and quartz veins in the valley of the Soldado in the province of Minas. Here, old flumes and ore-dumps point to previous workings, dating back to the days of the Spaniards, but long discontinued in consequence of the difficulty of transport, a difficulty which should disappear with the extension of the railway to Minas. Native copper has been found, though not in great quantity, in a limestone associated with the schist formation near La Sierra in the Maldonado province. Its origin is explained by the proximity of a deposit of copper pyrite from which it has evidently been separated. Curiously enough, no silver has been discovered in the whole of the La Plata, so that the origin of that name is somewhat mysterious. Sulphide ores have been known for years in a district extending some way inland from the coast at La Sierra in the province of Minas. They include argentiferous galena, copper pyrite, pyrite, and magnetic pyrite, alone or mixed and sometimes containing gold. In the San Francisco valley are found deposits of galena in quartz and dolomite, and copper pyrite, pyrite and magnetic pyrite are found in a quartzitic, fine-grained amphibolite. Oxide ores, especially those of iron and manganese, are widely distributed; in Northern Minas, near the source of the Upper Santa Lucia, a large bed of micaceous iron schist is known, but at present it is not possible to give any definite information as to the purity and richness of the ore. In the San Francisco valley (South Minas), there are zones of iron ore in the diabase and schist; these contain chrome iron ore but have not yet been worked. Lenses of hematite are found in the southern part of Cerro Largo, and in the sedimentary district in the north, a series of clay ironstone deposits have been found in the sandstone. To the north-west of Melo, these are well worth working as they contain a high iron content. The mica schist formation frequently contains, for example to the north of Nico Perez in the Trienta y Tres department, layers of quartz rich in magnetite. Important deposits of manganese are found at Zapucay in the province of Rivera, where the ores form two mountain ridges, the Cerro Iman and the Cerro Papageio. As regards coal, the author has been able to establish the continuity of the Brazilian deposits towards the south into Uruguay. In Uruguay, however, no seam reaches the surface, so that investigation is only possible by means of borings. It may be remarked that the Brazilian coal, by reason of its poor quality, has to be washed and briquetted before it has any commercial value.

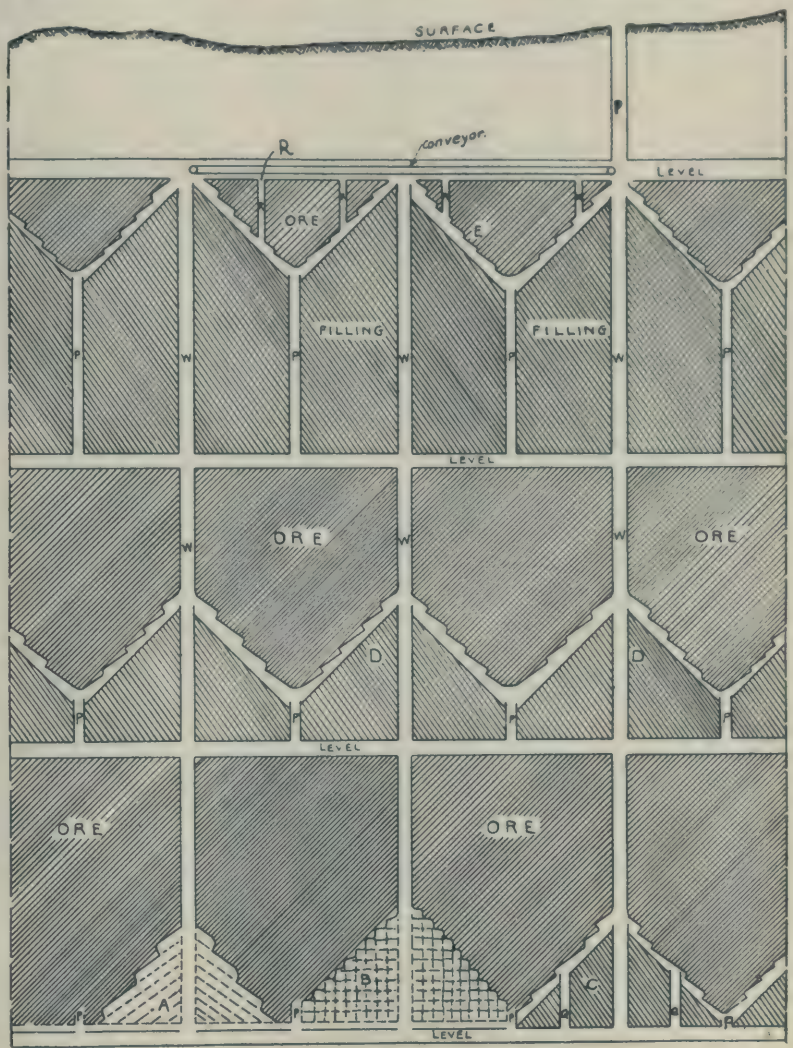
Condensation of Zinc Vapour.—A. Roitzheim in *Metallurgie* for October 8, discusses the conditions under which zinc vapour is condensed in the distilling process. It is known from practical observation that the vapour should be cooled slowly, as a sudden drop from the temperature of the retort to the melting point of the metal gives rise to an excess of zinc dust. The reduction of the oxide is effected, in practice, at a temperature between 900° and 1400° C., so there is no difficulty in keeping the nearer end of the condenser heated to about 870°; the zinc will then all be obtained in the liquid form. The outer end of the condenser has a temperature of 500° C. A portion of the vapour escapes into the outer receiver and is collected as zinc dust. The author shows that owing to the dilution with carbonic oxide the liquefaction can never be complete, and that at least 0·66% of the zinc will be obtained as dust. As a matter of fact, the yield even in a properly worked furnace amounts nearly to 3%, the excess being attributed to the difficulty of suitably moderating the temperature in the condenser. The greater portion of the dust is produced at the beginning of the distilling process, when the receiver is still cold.

Roasting Zinc Ore.—In *Metallurgie* for October 8 and 22, Felix Thomas gives an account of some experiments relating to the roasting of zinc blende. He finds that the decomposition of zinc sulphate by means of air rich in water vapour commences fairly rapidly at about 600° C. and that at about 820° C. the reaction is completed in a short time. The dissociation of sulphur, when water vapour is present, can therefore be effected at a temperature 100° C. lower than when dry air alone is employed. As regards zinc sulphide this is found to be decomposed by the aid of water vapour at temperatures as low as 650° C., with the production of zinc oxide and sulphuretted hydrogen. The author therefore proposes to briquette the sulphide ore by mixing it with a combustible containing hydrogen and capable of caking, such as tar, pitch, or caking coal. These briquettes, after drying, are roasted at a temperature of 700–750° C. in the oxidizing flame of a hydrocarbon, such as gas coal, water gas, or the distillation products of petroleum, the temperature at the close of the reaction being raised to 820° C.

Filling Stopes with Tailing.—At the September meeting of the Chemical, Metallurgical, and Mining Society of South Africa, Robert Allen contributed to the discussion on Edgar Pam's paper on filling exhausted stopes, read at a previous meeting, by describing the method of mining and filling that has been in vogue for some years at Kalgoorlie. This method is the rill system; it has been used in various parts of the world and has been described before; but at the present juncture an account of it as used at Kalgoorlie is of timely interest. Points to be noted are that the orebodies at Kalgoorlie are nearly vertical, and that all sorts of residues, not only sand, are utilized, and without any steps being taken to remove the cyanide. The levels are 200 ft. apart and are connected by winzes 150 to 200 ft. apart. These winzes are in the hanging wall side of the orebodies so that filling can be effected with a minimum of handling. The methods of stoping are shown at *A* and *B*, the former being chiefly used, as the holes can be drilled wet. The inclination of the benches is slightly flatter than that of the natural slope of the filling which is about 45°. Chutes *P* are cut halfway between the winzes *W*, and other intermediate chutes are shown at *Q*. The drifts are timbered, either by single stulls, or, if the lode is over 14 ft. wide, by saddlebacks, at intervals of 5 ft. The latter consist of pairs of stulls sloping towards one another like the rafters of a roof, and bearing upon a longitudinal ridging of sawn timber 2 in. thick. The stulls are lagged with poles about 4 in. diam. or with old iron pipes. The lagging is in turn covered with old filter cloths, or the sides and linings of cyanide cases, or any other inexpensive material which serves to prevent the residues from falling through. As stoping proceeds, passes *P* about 4 by 4 ft. are built about these chutes, usually of 7 in. logs, but sometimes of 9 by 3 in. sawn timber. Each winze

is also cribbed except when it will not be required later for passing filling to lower workings or for ventilation. In such a case the timbering of the level below the winze can be closed and the winze filled.

The breaking of the ore and the filling of the stopes with residue succeed one another alternately. Before the benches of ore are blasted, eucalyptus saplings or slabs are laid on the sloping surface of the filling. These serve to keep the broken ore separate from the residue, and assist in its rilling into the passes, little labour being thus required. The passes are then built up close to the working faces and covered to prevent residue from entering them, and the poles or slabs are removed. More residue is then dumped down the winzes into the stopes, filling them up to a convenient distance from the faces. When a stope has assumed the appearance shown at *C*, all the ore can be rilled to the passes *P*, and the intermediate passes *Q* are no longer entirely necessary. As stoping proceeds the appearance of the stopes is as shown at *D*. It is usual to stope a series of blocks on the same level simultaneously, so that the filling of the stopes with residue on both sides of the winzes and the building up of the passes can be carried on symmetrically. When the stopes are nearly exhausted, as shown at *E*, it is usual to sink subsidiary winzes *R* in the triangular blocks of ore left, through which the residues for filling can be dropped. The lodes in Western Australia are usually very steep, and the rill system of stoping and filling is particularly applicable to them. As the dip of the lodes decreases below 45°, more and more shovelling is necessary to assist the rilling, and the method becomes inapplicable when the dip is less than about 35°. Filling with residue in Western Australia has been in use for about 13 years, and its present cost is about 10d. per short ton of ore mined.



The Rill System of Stoping and Filling at Kalgoorlie.

The Platinum Market.—The *Engineering and Mining Journal* for November 5 gives a review of the course of the platinum market, with respect to prices and demand. In 1909 the price was the lowest for several years. During the first half of the year the price was $22 or 90s. per oz. and during the last quarter of the year it gradually rose to $29 or 120s. per oz. The upward movement since then has been remarkable, for the price has gradually risen to $39 or 160s. per oz. As is well known, the chief source of platinum is the Siberian gravel mines and the price is largely under the control of firms in London and Paris.

These controllers depress the price for the purpose of securing long contracts with the producers and subsequently do as they like with the market. Our contemporary is however of opinion that the present rise is not due solely to cornering, but to a real increase in the demand. One call for platinum, its chemical use, does not vary greatly from year to year; moreover a large proportion of the metal is not consumed, but returns in the form of scrap to be remade into chemical ware. Another use, that of dentistry, cannot vary largely. In the motor-car trade, where platinum is used for sparking points in the engines, there has been an actual decrease in the consumption, as compared with last year and the early part of the present year. The chief new demand at the present time comes from the jewellery trade in America, and to this the rise in price

is largely due. Fashion has decreed that platinum shall be substituted for gold in certain classes of work, and this has caused a considerable consumption of the metal. This, moreover, is not a use which is likely to be checked by an advance in price, as the purchasers are usually able to pay for and to demand what they want.

Zinc-Dust.—In *The Mining Journal* for November 26, Paul Speier contributes an article on zinc-dust, which is now of special interest to the gold metallurgist owing to its use in the Merrill precipitation process. The author points out that the dust is cheaper than shaving and acts much quicker ; and he mentions that for precipitation purposes the dust should contain at least 2% lead and a small quantity of nitrate of lead. The dust is produced in the process of distilling zinc ores and is caught in the collectors attached to the condensers. The dust formed during the first part of the operation contains a large proportion of oxide, but it also contains most of the cadmium present in the ore, so that it is more profitably used for the extraction of the latter metal ; the dust produced during the later stages is prepared as a merchantable article. With average ores of high grade the proportion of zinc produced as dust is from 10 to 15%. The dust is used largely in the preparation of indigo and aniline dyes, purification of fat, and has been applied for dry-galvanizing. The author devotes much attention to the dangers due to spontaneous ignition. If a barrel of zinc dust becomes damp, the oxidation may proceed so rapidly as to give off considerable heat, so that care must be taken to prevent the access of moisture.

Copper Precipitation at Butte.—On this side of the Atlantic we hear more of smelting practice than of wet metallurgy in connection with the Butte, Montana, copper mines, and many will not be aware of the fact that mine water and tailing heaps are treated by leaching and that the total yearly production of the district is as much as 300 tons of copper. Of this, three quarters is obtained from mine water and one quarter from old dumps. *Metallurgical and Chemical Engineering* for November contains an account of the method adopted for treating the dumps from the old concentration mill of the Montana Ore Purchasing Co. The plant is known as the ' Red Metal ' precipitation plant and it is under the superintendence of J. M. Gillie. The tailing when placed on the dumps contained about 1% of copper. There are two dumps, one rather larger than the other. The total area is 10 acres. The two dumps are treated separately. The surface of the dumps has been excavated into a series of terraced ponds into which leaching water is pumped. Tunnels have been driven along the bottom of the dumps 5 ft. high and 3 ft. wide at the bottom and 2 ft. at the top, and timbered throughout. They are 200 ft. apart ; in the large dump the total length of the tunnels is 1200 ft. and in the smaller 800 ft. It happens that the ground on which the dumps were built was covered with a bed of slime which forms a comparatively impervious foundation, so that not 20% of the liquors draining into the tunnels is lost by seepage. The water used for leaching is the acid water from the mine, that has been previously passed through precipitating plant and contains an inappreciable amount of copper. It contains about 3½ grammes of SO_3 per litre. The water is pumped into the ponds by phosphor-bronze centrifugal pumps. In the larger dump a 20-hp. pump provides 700 gal. per min., and in the smaller dump a 15-hp. pump delivers 400 gal. per min. The power is supplied electrically and costs $6 per hp. per month. The labour cost is low, only two day labourers and one night watchman being required. Operations have been conducted for 4 years and no diminution in the yield is as yet noticeable. The production is about ⅛ ton per day. The water is cut off occasionally and the ponds allowed to dry, in order that the accumulation of precipitated iron compounds such as peroxide and basic sulphate may be scraped away and removed. These compounds are deposited from the mine water which contain much iron. If the compounds were not removed they would stop the leaching action.

The water on draining into the tunnels contains from 0·015 to 0·03% copper. It runs down launders 4 ft. wide, 1 ft. deep, with a fall of ½ in. to the foot. At the larger dump the launders are 700 ft. long and at the smaller 512 ft. Such launders will treat 300 to 400 gal. per minute. Scrap iron and old (but clean) tin cans are placed in the launders for precipitation purposes. The total amount of scrap employed is 75 tons and 1000 lbs. has to be added daily. The iron is consumed at the rate of 1½ lb. for each pound of copper precipitated. The copper is swept from the iron every 2 hours and is carried by the flow of water to sumps at the end of the launders. From the sumps the precipitate is shovelled on to a drying platform and is shipped to the refinery with 15% moisture. The precipitate contains about 75% copper and 8% iron ; about 90% of the copper is recovered from the solution, and the richer the solution the more efficient the precipitation. The price paid for iron scrap is $8 per ton. In the sale of the precipitate the copper content, based on the wet assay, less 1·3%, is paid for at a price 4 cents per pound less than the market price for copper.

Goldfields of French Guiana.—In the November *Bulletin* of the American Institute of Mining Engineers, Albert F. J. Bordeaux, a French engineer, contributes a paper describing the goldfields of French Guiana. This country is in the north of South America between Dutch Guiana and Brazil. The geology of the country is little known. The country is covered with a tropical vegetation and the surface deposits consist largely of limonite and laterite. There are no mountains, only low undulating hills, except on the southern Brazilian border. The streams are numerous, narrow, and winding. Gold has been found in the river beds and banks in two belts of the country parallel with each other and with the coast. The first discovery was made in 1852 but general attention was not attracted until, in 1873, the placers on the Sinnamary river, especially that at St. Elie, began to yield large amounts of gold. In 1878 the placers on the Mana river were discovered, and in 1888 those on the Maroni river adjoining Dutch Guiana. The largest producer however was the Carsawene district discovered in 1893. This is further south in territory since awarded by Swiss arbitration to Brazil. In 1901 there was a rush to the Inini river and in 1902–3 to the Upper Mana where productive deposits were found. It is not easy to obtain figures for the yield of gold in French Guiana, but according to the official estimates the value of the gold extracted to the end of 1910 is 12 million pounds. The author is of opinion that the actual output was quite double this amount seeing that much of the gold was never reported at Cayenne, the capital, but was sold abroad. As already stated the surface deposits in the gold-bearing districts are limonite and laterite. Wherever the underlying formations have been investigated, and also at any outcrop of older rock, the geology consists of igneous or metamorphic rocks of pre-Cambrian formation, granite, schist, gneiss, amphibolite, quartzite, and their variants. In the river gravel the gold is found in a substratum of quartz sand and felspathic clay. This

is covered with a clayey soil full of tree roots. Hydraulicking is out of the question owing to the absence of fall and operations have generally been done by sluicing. The width of the gravel is narrow, never more than 20 ft., so that progress along the creeks is rapid. The author gives no specific figures for the contents of the gravel. During the last few years there have been no new discoveries of gravel rich enough for sluicing and recourse has been had to dredging. These dredges naturally work under great difficulties due to topography and want of skilled labour, so that the cost of operation and maintenance is high. The clayey nature of the material excavated also causes much trouble. The yield obtained by two dredges quoted by the author averaged 10d. per cu. yd. Prospecting for the veins from which the gold has been derived has not been conducted to any great extent, though auriferous quartz has been found in the river beds. In some parts quartz veins have been found traversing the laterite, and small stamp-mills have been erected. One company has 13 stamps but its ore is decreasing in value. The general conclusion after reading the author's paper is that there is plenty of gold in French Guiana and that the physical difficulties of prospecting and mining are great.

Electrolytic Analysis.—In the *Mining and Scientific Press* for October 25, R.C. Benner discusses various rapid methods for estimating metals by electro-deposition. We gave some information on the subject in our Précis of February last. After describing the devices for rotating the cathode, anode, or electrolyte in order to increase the rate of deposition, Mr. Benner draws attention to the mercury cathode, a device which he considers has not yet received the attention it deserves. The apparatus consists of a glass beaker of 50 cc. capacity containing from 40 to 50 grammes of mercury. A platinum wire is fused through the glass at the bottom of the side. About 20 cc. of the solution to be electrolysed is introduced into the beaker above the mercury and a suitable anode lowered into it. The current used is usually one of from 3 to 4 amperes. By its means it is possible to deposit as much as half a gramme of many of the metals in 15 to 20 minutes and to make a determination as accurately as by most other methods. In some cases such as that of bismuth the ease and accuracy are greater. Some of the most difficult chemical separations can be successfully made by this method. For instance the iron and titanium contained in titaniferous iron ore can be separated readily, by electrolysing the solution of the ore in sulphuric acid. If the amount of iron present is from 0·1 to 0·2 grammes and the amount of solution is not too great, the iron can be deposited in the mercury in 20 minutes. The increase in weight of the mercury cathode gives the amount of iron present. The electrolyte can then be reduced by zinc and the titanium titrated in the usual manner. In the above experiments it is supposed that the anode is stationary. A still more rapid extraction can be obtained by rotating the anode.

Zinc Deposits in Tennessee.—*Mining Science* for November 3 quotes a Bulletin, published by the Tennessee Geological Survey, in which S. W. Osgood describes the zinc district of east Tennessee. This district was originally mapped by the United States Geological Survey in the years 1896 to 1901 and the deposits have been worked spasmodically since 1883. Mr. Osgood designed a concentration plant in 1907 to treat 120 tons per day and this is to be extended in the near future. Though the deposits have been known for some time and have been described by other writers, the present position in connection with the American zinc production gives the deposits a special interest. The ore is found in the so-called Knox dolomite, a formation belonging to the Lower Silurian series. There are three approximately parallel belts 40 to 50 miles long and 20 miles apart. The belts are a few hundred feet wide and have a north-easterly strike following the general strike of the Appalachian system of folds and faults. The zinc sulphide is found chiefly in zones of cross-fracture as a filling of the brecciated fissures; calcite and dolomite are also in the fissures. As regards barite the various workers have had varying experience. In some cases it is not present but at other places it has seriously hindered

The Zinc District in Tennessee.

concentration. The zinc veins are as a rule quite narrow and penetrate the dolomite in all directions. In most of the mining operations recourse has been had to hand picking, but the author is in favour of treating the deposits as stockworks. As it is, much of the excavation is in the form of open quarries and if these were developed on a large scale the mining could be done by steam shovel. The ore so mined would give about 4 tons of concentrate averaging 55% zinc for every 100 tons of ore. At Mr. Osgood's mill this is the average result, but the recovery is not high, being not more than 60%. The only local smelter is a small one at Clinton belonging to Edes, Mixter & Heald. In addition to the sulphide, carbonate and silicate are found at the surface and these have been mined for many years. The sulphide is of good quality, being light coloured and free from iron, manganese, lead, arsenic, and antimony, so it produces an unusually pure metal. The district is unusually favourably situated as regards supplies of coal. There is some probability that the deposits will be worked on a large scale before long.

BOOKS REVIEWED.

ROCK-DRILLS; THEIR DESIGN, CONSTRUCTION, AND USE.—By Eustace M. Weston. Cloth, 8vo, 373 pages. Ill. New York: McGraw-Hill Book Co. Price 17s. For sale by *The Mining Magazine*.

For some years there has been a continual inquiry for a book devoted to modern rock-drills, so that the present volume will be welcomed by mining engineers. The author is an Australian who received a technical training at the Ballarat School of Mines and has been for some time lecturer on mining at the Transvaal University College. He has the qualification of having had to earn his living by using many of the machines described and of having superintended many rock-drilling operations. Perhaps one reason why a book on the subject has not been published recently is that the evolution of the machine drill is proceeding so rapidly that the last word cannot yet be said. The author admits that his book is by no means final, but it contains sufficient information relating to current practice to make it of value.

After a historical account of the development of machine drills, the author gives working details of all the standard patterns on the market and then proceeds to give similar information about hammer drills; chapters on electric drills and electric-air drills follow, and a chapter is devoted to drills that use air expansively. Rotary drills and those operated by gas and oil engines are not described. The method of operating, the philosophy of their application, their maintenance, drill steel and drill bits, form the subjects of chapters, and subsequently the author devotes much space to the nature and use of explosives and the theory and methods of blasting. Examples of rock-drill practice are given, describing the methods of stoping and arranging shot-holes, the examples being drawn from South Africa, America, and Australia. Other chapters deal with tests and contests, and with the prevention of dust. Much of the information on practice outside South Africa has been culled from other authors in books and periodicals, but the bulk of the book is based on the writer's first hand experience.

PRINCIPLES OF METALLURGY.—By Charles H. Fulton. Cloth octavo, 540 pp. Ill. New York: The McGraw-Hill Book Co. Price 21s. For sale by *The Mining Magazine*.

This book covers practically the same ground as Roberts-Austen's Introduction to the Study of Metallurgy, and the author undertook the work chiefly for the reason that this 'Introduction' had not been revised for many years. It happens that last month we reviewed the new edition brought out by F. W. Harbord. Mr. Fulton is principal of and professor of metallurgy in the South Dakota School of Mines, and is already known as the author of a book on Fire Assaying. After an introductory chapter on the history of metallurgy, the author devotes chapters to thermal analysis, and the physical properties of metals, and then proceeds to the study of alloys and their physical properties. Chapters follow on the measurement of high temperatures, and on typical metallurgical operations describing the chemical reactions used in metallurgy. A lengthy chapter is devoted to slag, and is based on Vogt's treatise. Another chapter discusses the physics and chemistry of matte, speiss, and bullion. Refractory materials and fuel are then treated at length. The remainder of the book is occupied with the description of typical metallurgical furnaces. The book generally is more theoretical than practical and the examples of practice quoted are not always the most successful. For instance Mond gas can hardly be taken as a successful type of gaseous fuel; and as regards concentration by flotation, though the author notes a comprehensive article on the subject from *The Mining Magazine*, he is content with a short description of the old Elmore process. Much of the information in the book is drawn from German sources and much is thereby introduced that is new to American readers. Metallography has received much attention at the hands of English writers recently, so that this part of the book will not attract special attention on this side, and as regards the study of metallurgical operations, we shall probably still rely on E. D. Peters' and J. W. Richards' well known books.

DRYING MACHINERY AND PRACTICE.—By Thomas G. Marlow. Cloth octavo, 340 pp. Ill. London: Crosby Lockwood & Son. Price 12s. 6d. For sale by *The Mining Magazine*.

This book deals with the theory and practice of drying and dessicating, and covers ground that has not hitherto formed the basis of a general treatise, though much information is continually appearing on the subject in the technical Press. The removal of moisture is a problem of importance in many operations; and decantation, drying by heat, vacuum-pans, filters, centrifugals, etc., have a variety of applications. In judging this book we naturally turn to the part most familiar to us and find that the decantation and filtering of gold ores is treated in an incomplete manner, only indications of the applications and not authoritative details being given. The machines advertised by two companies are described and illustrated, but no mention is made of the most successful of the dewaterers and filters known in the metallurgical world.

COMPOSITION AND HEAT-TREATMENT OF STEEL.—By E. F. Lake. Cloth octavo, 250 pages. Illustrated. New York: The McGraw-Hill Book Co. Price 8s. 6d. For sale by *The Mining Magazine*.

The author is the "Steel Editor" of the *American Machinist*, a paper devoted to machine tools and their applications. Much of the book is devoted to elementary accounts of blast-furnaces, electric refining furnaces, rolling mills, etc. The effects of other elements on iron are described, and the remainder of the book deals with annealing and hardening.

TECHNOLOGICAL DICTIONARY: ENGLISH-SPANISH, AND SPANISH-ENGLISH.—New Edition. By Nestor Ponce de Leon. Two Vols. large octavo. Price 36s. each. London: Hirschfeld Brothers. For sale by *The Mining Magazine*.

This Spanish Dictionary is well known and is valued by those who are interested in general engineering. It is not however, much use for specialists in metallurgy. The new edition consists of a reprint of the old edition, to which a short supplement is added.

ELEMENTARY CRYSTALLOGRAPHY.—By W. S. Bayley. Cloth, 8vo. 260 pp. Ill. New York: The McGraw-Hill Book Co. Price 8s. 6d. For sale by *The Mining Magazine*.

The author of this book is well known as the lecturer on mineralogy and economic geology in the University of Illinois, and as the business editor of *Economic Geology*. The book is an introduction to a treatise on mineralogy now being prepared by him. It is not a complete record of crystalline forms but is intended as a guide to the study of the principles of the science, for the use not only of the mineralogist but of the chemist and physicist.

ILLUSTRATED GUIDE TO THE FEDERATED MALAY STATES.—Edited by C. W. Harrison, of the Malay Civil Service. Pocket size, 330 pages, with illustrations and map. Price 2s. 6d. London: The Malay States Development Agency. For sale by *The Mining Magazine*.

This is in every sense a charming little book written in easy style by men who know their country well. The illustrations, both from photographs and in colour, are beautiful, and the map is valuable. In addition to a general topography, the book contains intimate accounts of the manners and customs of the country and many useful hints for strangers about health, dress, food, etc.

PRACTICAL SHAFT SINKING.—By Francis Donaldson. Cloth, 8vo, 150 pages. Ill. New York: The McGraw-Hill Book Co. Price 10s. 6d. For sale by *The Mining Magazine*.

This book consists chiefly of a reprint of a series of articles that have recently appeared in *Mines and Minerals*. It contains a useful record of methods adopted in America for sinking through soft, wet, or treacherous ground.

BUSINESS PROSPECTS YEAR BOOK, 1911.—Edited by Joseph Davies and C. P. Hailey. Cloth, 8vo, 300 pages. Cardiff: The Business Statistics Publishing Co.; London: *The Financial Times*. Price 5s.

This book gives statistics relating to coal, iron, copper, tin, tinplate, oil, rubber, and many other branches of British industry. The results for 1910 are estimated and the general course of events during 1911 indicated. For instance the forecast for tin is that during 1911 the "demand will increase to a greater extent than the supply, and prices will average higher figures than any year since 1907." Of copper it is prophesied that the "output will be kept below consumption, the average price will be above that of 1908-9-10, and copper securities will improve in value."

REPORT OF THE DEPARTMENT OF MINES ON THE GOLDFIELDS OF NEW ZEALAND FOR 1909. — By Frank Reed. Wellington, New Zealand: John Mackay.

This yearly report is as usual full of interesting information about the progress of mining in New Zealand. The chapter on dredging is timely, as also is that on Waihi, which is illustrated by many sections of the mine.

GEOLOGY OF THE GRAYBACK MINING DISTRICT, COLORADO.—By H. B. Patton, C. E. Smith, G. Montague Butler, and A. J. Hoskin. Cloth, 110 pages, with maps and illustrations. Boulder, Colorado: The Colorado Geological Survey.

This district was once famous for its iron mines, and later for gold mining, both lode and placer. It is considered to offer good opportunities for further prospecting.

MANGANESE DEPOSITS OF THE UNITED STATES.—By E. C. Harder. Octavo, paper covers, 300 pages. Ill. Washington: The United States Geological Survey.

This is Bulletin 427 of the Geological Survey, and it describes in detail the occurrence of manganese ores in the United States. Manganese is not one of the metals found in notable quantities in North America, and the ironmasters there draw chiefly on India for their supplies. The Bulletin describes the occurrence and methods of mining in other parts of the world, and discusses the uses and chemistry of the metal.

CURRENT LITERATURE

Concentration at Cananea.—In the *Mining and Scientific Press* for September 10, Courtenay de Kalb gives an account of present practice in concentration at Cananea, Mexico, and describes the Cole dewatering shovel wheel and the Cole drag-classifier.

Hostotipaquillo.—In the *Mining and Scientific Press* for September 10, S. J. Lewis gives an outline of the geology of the Hostotipaquillo mining district in Jalisco, Mexico, where silver sulphide ore containing gold is found.

Summer Travel in Mexico.—In the *Mining and Scientific Press* for September 10, J. A. MacDonald gives an account of the conditions of travel in Mexico during the summer months, especially giving his experiences in Chihuahua, Sinaloa, and Sonora.

Electric Haulage in Colorado.—In *Mining Science* for September 15, F. P. Wood describes the electric system of haulage installed at the Portland Mine, together with the dumping device

Iron and Coal in Mexico.—The September *Bulletin* of the American Institute of Mining Engineers contains an article on iron ore and coal deposits in the State of Oaxaca, Mexico, written by J. L. W. Birkinbine.

Analysis at Cananea.—In the *Engineering and Mining Journal* for October 1, F. G. Hawley gives an account of the methods of chemical analysis adopted at the Cananea copper mine, Mexico.

Pumping at the Candelaria Mine.—In the *Engineering and Mining Journal* for October 1, G. A. Laird describes the water difficulty at the Candelaria mine, Chihuahua, Mexico. The orebody is composed of porous oxides and carbonates of lead and iron and is permeated with water, while the country rock is quite dry.

Slag Cement.—In the *Engineering and Mining Journal* for September 24, F. A. Talbot describes the Colloseus process for making cement from the slag from iron blast-furnaces. The process consists of bringing the molten slag into contact with a solution of sulphate of magnesium, the effect being to remove the sulphur from the slag.

Erosion of River Banks.—In the *South African Mining Journal* for September 24, W. H. Knott, government land surveyor, discusses the comparative rate of erosion of river banks. In South Africa there is a tendency for the beds of the rivers to move in a northerly direction, and some physicists had attributed it to the centrifugal force of the earth's rotation driving the water towards the equator and thus pressing more upon the northern bank. Mr. Knott, however, shows that the greater erosion of the northern banks is due to the fact that the southern banks are more exposed to the sun's rays and become more baked and hardened than the northern banks.

Colorado Zinc Ores.—H. C. Parmelee, in *Metallurgical and Chemical Engineering* for October, describes the concentration plant of the Marion mine, Fairview, Colorado, where zinc sulphide is found with sulphides of iron and copper finely disseminated through granite and schist. The whole of the ore is reduced by rolls and tube-mill to 40-mesh and treated on Card tables; only 10% of slime is made.

Eccleston's Concentrator.—The *Mining World* (Chicago) for October describes a new concentrating table made by the Eccleston Machinery Co., Los Angeles, California.

Pilbarite.—The *Australian Mining Standard* for September 7 quotes a paper by Edward S. Simpson, read before the Natural History and Science Society

of Western Australia, describing a new mineral called pilbarite, that has been found at Wodgina in the Pilbarra goldfield. This mineral is rich in uranium and thorium and is highly radio-active.

Oil in Australia.—The *Australian Mining and Engineering Review* for September 5 gives an account of the progress of the oil-shale properties of the Commonwealth Oil Corporation, New South Wales.

Pumping at Bisbee.—In *Mines and Minerals* for October, C. C. Austin describes the pumping plant of the Superior & Pittsburg Copper Co., at Bisbee, Arizona.

Rapid Tunneling.—We have several times referred to the rapid tunneling work in connection with the new water-supply for Los Angeles, California. A full illustrated account of this work is given by R. L. Herrick in *Mines and Minerals* for October.

Mine Timbering. — In *Mines and Minerals* for October, L. L. Wittich gives information about methods of timbering in soft ground in the Missouri zinc mines.

Copper Estimation.—In the *Western Chemist and Metallurgist* for September, Arthur Austin gives a paper describing the routine of copper estimation at a smelter in Western America not specified by name. The materials to be assayed vary within narrow limits, so accuracy is important. Anything containing less than 2% copper is treated colorimetrically and richer material by the cyanide assay.

Aerial Transport in Utah.—In *Mines and Minerals* for October, L. A. Palmer describes the aerial ropeway built for the purpose of transporting copper ore from the Utah Consolidated to the new Tooele smelter of the International Smelting & Refining Co.

Shaft-Sinking.—In *Mines and Minerals* for October, W. A. Weldin discusses the relative value of the elliptical and rectangular forms of shafts with concrete linings.

Converter Practice.—A. R. McKenzie, of the Great Falls smelter, discusses in the *Engineering and Mining Journal* for October 15 the phenomenon of foaming of slag in converters. He attributes it to the fact that with low grade matte the level of the slag may be below the tuyeres.

Cobalt.—In the *Engineering Magazine* for October, Arthur A. Cole gives a review of present position of mining at Cobalt, Ontario.

Porcupine.—In the *Canadian Mining Journal* for October 15, Reginald E. Hore gives impressions of Porcupine district, Ontario.

Gilpin County Practice.—In the *Mining and Scientific Press* for September 17, George E. Collins discusses mining practice in Gilpin County, Colorado. He regrets the abandonment of the contract system and the substitution of time wages, showing that the efficiency of labour has greatly decreased when the change was made.

Metallurgy at Kalgoorlie. — In the *Mining and Scientific Press* for September 24, A. E. Drucker gives an account of the present metallurgical practice at Kalgoorlie. Among other things he gives the flow-sheets at the Kalgurli and South Kalgurli.

Cyanide Agitation Vat.—In the *Mining and Scientific Press* for October 15, Lee Fraser describes an agitator for cyanide extraction designed by him for use in Costa Rica.

Ore-deposits in Depth.—In the *Mining and Scientific Press* for October 15, F. Lynwood Garrison contributes to the discussion on the question of the persistence of ore shoots in depth, pointing out that the principle of exhaustion with depth, though a sound one, is ridden too hard by many geologists.

Estimation of Mercury.—In the *Engineering and Mining Journal* for October 22, G. A. James describes his method of assaying for mercury in ores.

Churn Drills.—In the *Engineering and Mining Journal* for October 22, H. A. Field describes the methods and results of churn-drilling in one of the copper properties at Miami, Arizona.

Assaying Ores from Cobalt.—In the *Engineering and Mining Journal* for October 22, D. K. Bullens discusses the methods of assaying the silver ores from Cobalt containing arsenic, cobalt, and nickel. With high silver content he prefers scorification, and with low silver content the crucible method with high litharge is preferred.

West Australian Mineral Resources.—The *Australian Mining and Engineering Review* for October contains a lengthy article by A. Gibb Maitland, the Government Geologist on the mineral wealth of Western Australia. This article describes in detail the various goldfields of the State, and the author in a future article will deal with other metals found there.

Lead Sulphate Pigments.—In the *Engineering and Mining Journal* for November 5, J. I. Blair describes a process used in two lead-smelting works in the United States, not specified by name, by which galena is given a sulphatizing roast and a fume produced consisting chiefly of sulphate of lead.

Copper in Bolivia.—In the *Engineering and Mining Journal* for November 5, Robert Hawxhurst describes the Carangas copper deposits in Bolivia, 80 miles west of Oruro.

Mining at Cananea.—In the *Engineering and Mining Journal* for November 5 and 12, Mr. J. Elsing describes the mining methods employed at the Cananea copper mine, Mexico.

Queensland Mining.—In the *Queensland Government Mining Journal* for October, L. C. Ball describes the silver-lead-zinc ore deposits of the Burketown district.

Vanadium Steel.—In the *Iron & Coal Trades Review* for September 9 and 23, October 7 and 21, and November 11, J. Kent Smith and W. L. Turner contribute articles on the action of vanadium in hardening steel.

Manufacture of Tungsten.—The *Engineering and Mining Journal* for November 12 publishes an article by L. R. Pratt, of Grasselli, on the manufacture of metallic tungsten. The article is in the form of a precise description of the operations, but as two of the reagents are "secret compounds," its value as a contribution to technology is nil.

Reduction of Calcium Sulphate.—In the November *Bulletin* of the American Institute of Mining Engineers, H. O. Hofman and W. Mostowich give the results of their experiments on the reduction of calcium sulphate to sulphide by carbon and carbonic oxide, and apply the facts obtained to a study of the action of gypsum when added to a blast-furnace charge as a sulphurizing flux.

Siberian Mining.—In the *Mining and Scientific Press* for November, F. L. Lowell describes native methods of alluvial mining in Siberia.

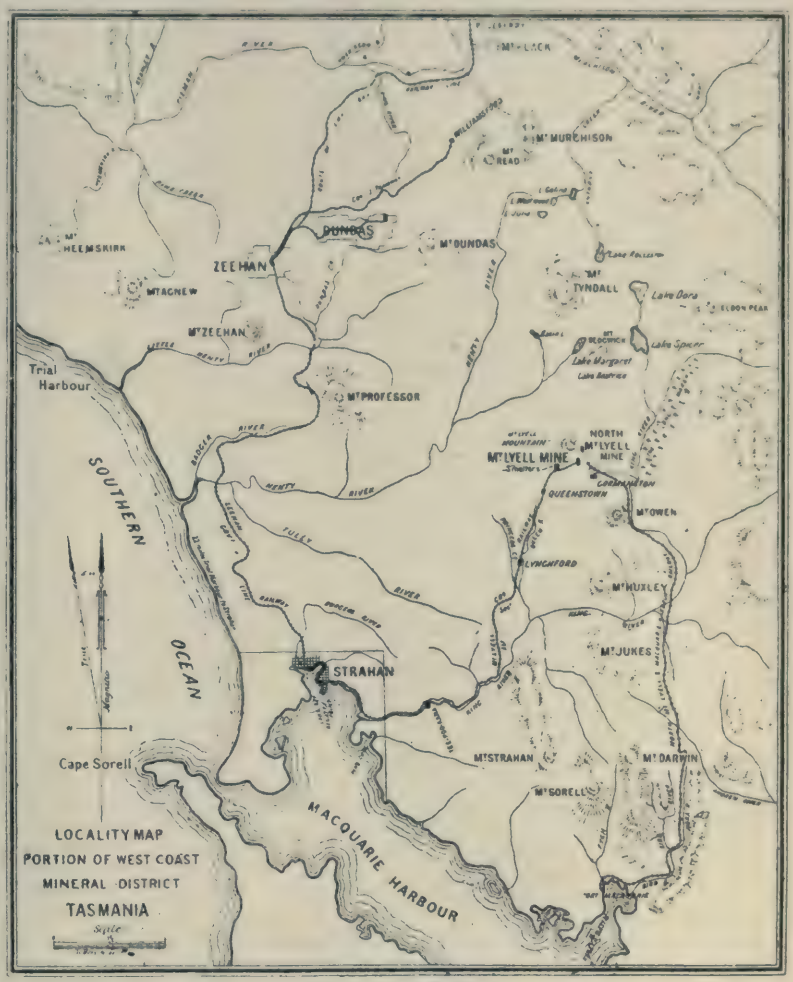
Mining in the Argentine.—In the *Mining and Scientific Press* for October 29, Charles Janin gives a review of the mineral resources of the Argentine Republic.

Refining Bullion at Waihi. — In the *Australian Mining Standard* for October 26, J. G. Goosman describes the method adopted at Waihi for parting the gold and silver and for the production of bullion from the slime deposited in the electrolytic bath. The plant is new; and the author describes the practice in great detail.

COMPANY REPORTS

Mount Zeehan (Tasmania) Silver-Lead Mines.—In our January issue we gave an abstract of the report of this company for the year ended June 30, 1909, and we showed that the mine after yielding profits for 20 years had become exhausted. The report for the year ended June 30 of this year states that further prospecting and development have as yet yielded no results. During the year Thomas Vincent, the manager, heard of important discoveries at Dundas, 6 miles distant, and immediately on his own responsibility secured an option. This property proved to be of great promise and the company completed the purchase. A subsidiary company called the Zeehan-Dundas Mines was formed with a capital of £20,000, half of which has been provided by this company and the remainder by the Zeehan-Montana and other allied companies and by individual shareholders. The Zeehan-Dundas property is in the primeval forest and some of the galena veins 2 ft. wide stand out among the peat and soil. The outlook is most promising. The tailing heaps belonging to the Mount Zeehan have not yet been treated and experiments show that a slight modification of the existing plant will afford a ready means for their beneficiation.

Mount Lyell Mining and Railway.—The results for the half-year ended September 30 have been received in London by cable. The amount of ore treated was 198,617 tons, of which 126,707 tons came from the Mount Lyell, and 71,910 tons from the North Mount Lyell. The average content was 2·41% copper, 1·78 oz. silver, and 0·58 dwt. gold. The produce was 4077 tons of blister copper containing 4028 tons copper, 325,509 oz. silver, and 5672 oz. gold. The total ore treated was 9000 tons greater than in the previous half-year and the output of blister copper was 87 tons less, the reason being that some of the ore from the North mine was of rather lower grade than usual. In the report for the half-year ended March 31 it was stated that 1359 tons of copper remained unsold. It is now reported that this was subsequently sold at £59 per ton. Of the production during the last half-year, 3241 tons have been sold at an average price of £57. 7s. 10d., leaving 787 tons unsold. After paying £5594 for taxes, and charging £10,147 to depreciation, and £10,031 to exploration and removal of overburden, the net profit was £90,533. This figure is £25,000 less than during the previous half-year, due chiefly to the decreased price of copper. The dividend absorbed £75,000, being at the rate of 1s. 3d. per £1 share. The cost of producing blister copper was 16s. 5d. per ton of ore, practically the same figure as before. The reserve on September 30 was 2,720,693 tons at the Mount Lyell, assaying 0·53% copper, 1·96 oz. silver, and 0·56 dwt. gold, and 927,683 tons at the North mine, averaging 6% copper, 1·33 oz. silver, and 0·1 dwt. gold. The addition to the reserves is 85,520 tons, a greater increase than during any previous period. At the North mine the orebody on the 850 ft. level is in places of greater size than was anticipated, and developments on the 1050 ft. and 1100 ft. levels are giving good results. In addition to the copper ore, 3751 tons of sulphur ore from the Mount Lyell and 4706 tons from the Chester mine were sent to the acid works. Prospecting continues at the Norfolk range properties, and though there is some encouragement for further work nothing of real value has yet been found. The accompanying map shows the relative positions of Mount Lyell, Zeehan, and Dundas, and serves to draw attention to the close proximity of three different ore deposits, pyrite at Mount Lyell, silver-lead at Zeehan and Dundas, and tin at Dundas. The tin deposit at Mount Bischoff is a few miles further north.



Mt. Lyell and Zeehan.

Huelva Copper & Sulphur.—This company was formed in 1903 to acquire pyrite mines in the South of Spain. The control was in France though the registered office was in London. The management and administration proved far from satisfactory and in 1909 a drastic re-organization was effected. W. J. Barnett proceeded to Spain and made a thorough examination, and Henry F. Collins was appointed manager. When the new board enquired into the financial position they found that the capital had been applied for all sorts of doubtful purposes, none of them connected with the proper development of the mine. Not only so but a ruinous contract had been made for the sale of pyrite and that money had been received for it in advance of delivery. The progress of the company has therefore been impeded and the policy of the new board has been to mine just sufficient ore to fill the unfortunate contract and to put all energies into the development of the orebodies. In order to eventually reap adequate profit, the consulting engineer and the manager are united in recommending smelting on the spot, but this policy has to be postponed as there are no available funds. In the meantime efforts are being made to call in some of the money abstracted by the previous directors who have been forced to assume personal responsibility. When the company has straightened its finances and the engineers have developed the mines further, there will be an opportunity for the provision of further working capital. Mr. Collins' report dated August 2 shows that at the Romero, Angelita, La Corta, and San Alberto mines there are large reserves of copper ore suitable for smelting and concentration, as well as much ore valuable for its sulphur content. During 1909, about 25,000 tons of 5% ore was shipped and about 45,000 tons was sent to the cementration ground.

Gaika.—This company belongs to the Rhodesian Exploration & Development group and was formed in 1902 to acquire the Gaika gold mine near Que Que. Crushing commenced in 1905 and the plant consists of stamps and Huntingdon and Chilean mills. H. E. Jones is consulting engineer and P. A. Cockburn is manager. During the year ended June 30, 31,474 tons yielded 10,585 oz. by amalgamation and 2343 oz. by cyanide, making a total production of gold of 12,928 oz. worth £54,857 or 34s. 6d. per ton. The working cost, including debenture interest and London expenses, was £39,190 or 24s. 10d. per ton. After allowing for depreciation of plant the net profit of the year was £11,715, out of which £10,363 has been written off the development account. Development has been centred on the Lucy Reef and North Shaft, and ore has been found at both these parts. The reserve on June 30 consisted of 23,500 tons of ore containing 15 dwt. per ton and 16,500 tons of ore of poorer quality.

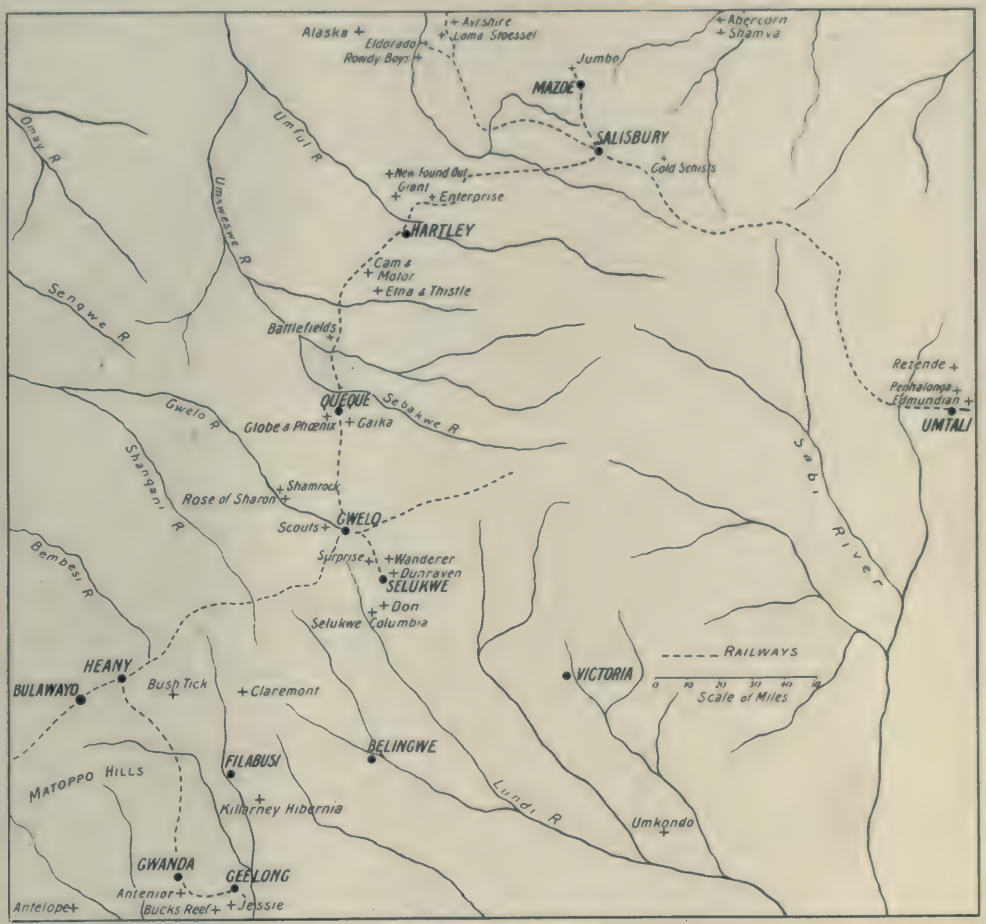
Jumbo Gold Mining.—This mine is situated in the Mazoe Valley, Rhodesia, and has been producing since May 1906. The company is in the control of the United Rhodesia Gold Fields, and the staff of the Consolidated Gold Fields of South Africa are the consulting engineers. The report for the year ended June 30 last shows that the results of developments are far from satisfactory. During the year the 30 stamps crushed 36,658 tons and the yield by amalgamation and cyanide was worth £85,457. The number of tons treated was 5000 greater than the year previously and the amount recovered was about £1000 less, which shows that the average yield has decreased slightly. The report by W. F. N. Dudgeon and H. A. Piper shows that the ore reserve has not been maintained. The year under review began with a reserve of 73,336 tons averaging 14½ dwt. and on June 30 last stood at 39,249 tons averaging 10 dwt. Little new ore has been found and a block of probable ore has turned out to be valueless. The outlook when the report was written on July 21 was far from bright, but in a supplementary report dated November 7, H. A. Piper states that on the 5th level the eastern orebody has been proved for a length of 335 ft. averaging 21·9 dwt. over 37 inches so that the position of the mine is not so bad as was supposed. For the year the total income was £85,942 and the expenses £43,000; in addition £12,070 was allowed for depreciation and £9164 for redemption of development account. The balance of profit was £18,632, out of which £15,000 is to be devoted to further development work.

Selukwe Columbia.—This company owns a mine in the Gwelo district of Rhodesia and was formed in 1900 by the Rhodesian Exploration & Development Co. Operations were not successful at first and the mill was closed. By reconstruction in 1908 additional funds were raised and extraction was commenced in May 1909. The report now issued covers the year ended June 30, 1910. The ore is refractory and it is crushed in Chilean mills and grinding pans. During the year 25,764 tons was treated and yielded 6361 oz. by amalgamation and 3025 oz. by cyanide, the total extraction being worth £39,841. The cyanide installation has been extended during the year by the provision of fine grinders and slime plant capable of treating 900 tons per month. By this means the ratio of extraction which is now 82% will be substantially increased. During the year the working cost was £30,971 and in addition £10,413 was spent on capital account. H. E. Jones, the consulting engineer, reports that the ore reserve on June 30 was 27,000 tons containing 12 dwt. gold. The main shaft is now at the 5th level and the auxiliary shaft at the eastern end is down to the 4th. Development work is being actively pushed and the grade and quantity of ore is improving.

Wanderer.—This company operates in the Selukwe district of Rhodesia and was reconstructed in July 1909. It was originally formed in 1899 to develop the Wanderer, Ashton and other mines, and production commenced in 1902. From the years 1903 to 1906 the yield averaged 25,000 oz. per year, but later fell away and in 1909 the Camperdown property was acquired. Percy Tarbutt & Co. are the consulting engineers and J. B. Little is manager at the mines. The directors' report now issued covers the nine months ended April 30, but the engineers' report for the sake of comparison covers the full year May 1, 1909, to April 30, 1910. On reconstruction 431,386 shares of 5s. each were given to shareholders in the old company and 134,000 were given as purchase price for the Camperdown mine; at the same time 34,600 shares were subscribed at par. As an aerial ropeway 2½ miles long had to be built to connect the Camperdown and the Wanderer, production from the former did not commence until July of this year. The ore at the Wanderer and Ashton mines is of very low grade and it is crushed by rolls and treated by cyanide. During the year ended April 30, 190,278 tons were crushed, yielding 13,112 oz. or 1·378 dwt. per ton. This was 77% of the estimated content. The value of the gold recovered was £55,741, a decrease of £24,765 as compared with the year before, due to the fall in the gold content of the ore mined. The working cost including development was £66,009. Since the Camperdown mine started delivery, the average content of the ore treated in the mill has substantially increased, the monthly output during August, September, and October averaging £9500, or double that of the past year. The estimate of reserves has been revised, the figures at the Wan-

derer and Ashton being 243,745 tons and at the Camperdown 450,000 tons; the content is not stated.

Eldorado Banket.—This company was floated in 1906 by the Rhodesian Exploration & Development Co. to acquire a developed gold property in the Lomagunda district of Rhodesia. Milling commenced in September 1907. The ore is refractory and the plant consists of stamps, chilean mills, Forwood-Down pans, and cyanide plant. The report for the year ended March 31 last shows that 80,566 tons of ore was crushed, yielding 35,590 oz. by amalgamation, and that the cyanide plant extracted 10,230 oz. The value



SOUTHERN RHODESIA.

of the total yield was £195,214 and the working profit was £107,203. These figures show an increase over those of the previous year when the profit was £66,955. From the working profit, London expenses £4919 and depreciation £20,634 were deducted leaving £81,513 available for distribution. The dividends absorbed £75,000, bringing up the total to date to £120,000, equal to 40% on the capital £300,000. H. E. Jones, the consulting engineer, describes the developments for the year, and shows that on March 31 the reserve was 196,458 tons averaging nearly 18 dwt. The orebody has been opened to the 6th level and at that depth measures 422 ft. long, and assays 1 oz. across a width of 6 ft. Work is now being done for the purpose of developing the lode at the 7th level. During the year, £41,143 has been spent on capital account on plant, buildings, and in sinking additional shafts.

Rooiberg Minerals Development.—This company was formed in May 1908 to acquire tin mines in the Transvaal, situated on the northern slope of the Rooiberg range of hills, 40 miles west of Warmbaths station, and 70 miles north by west of Pretoria. The control was at first with the Oceana Company, but is now with the Anglo-French-Farrar group. The report for the year ended June 30 showed that the 10-stamp mill crushed 15,713 tons and produced 622 tons (of 2240 lb.) of tin concentrate having an average content of 68·3%. The extraction was only 62% and the middling, tailing, and slime have been saved for further treatment. The new consulting engineer, E. J. Way, requisitioned the services of Amos Treloar, who did much good work at the dressing works at East Pool, Cornwall. Between them they are designing a modified plant with the object of effecting a greater saving. The developments at the mine are in the meantime proving satisfactory and the reserve on June 30 was 24,300 tons averaging nearly 5% metallic tin. The receipts from the sale of concentrate were £56,135, and the working profit was £12,681. During the year the capital of the company was raised from £150,000 to £180,000 by the issue of 30,000 new shares which were sold at 30s. As options on 30,000 additional shares

have been granted at 35s. to mature in May 1912, a further creation of capital may be necessary.

Lena Goldfields.—This company was formed in 1908 to acquire the control of a Russian company, the Lenskoie, which has worked for many years alluvial gold deposits in valleys adjoining the Vitim river, a tributary of the Lena. Bodaibo is the town on the Vitim forming the base of operations. It is at the mouth of the river of the same name. The flotation in London was in the hands of the Venture Corporation and the Consolidated Gold Fields of South Africa, for whom C. M. Rolker reported on the properties. The annual report now issued is the second, and covers actually a period of 15 months from July 1, 1909, to September 30 of this year. The total share capital is £1,122,216 in £1 shares, of which 753,838 were purchase price and 368,378 were issued for working capital, the total amount received being £401,815. Part of the company's holdings in Lenskoie shares have been sold but the proportion still held is 71½%. The revised figures for the profit of the Lenskoie for the year October 1908 to October 1909 was £519,455 as against £400,000 estimated. For the year October 1909–10 the extraction as reported by C. M. Rolker was about £1,600,000, and the managing director, Baron Alfred de Gunsburg, estimates the profit for the year at £600,000. The Lena Goldfields, in the profit and loss account to September 30, shows a profit of £262,386, chiefly derived from the profits of the Lenskoie for the years 1907 to 1909. The only dividend so far distributed was one of 10% paid on November 25 last year absorbing £112,221, and the directors now recommend the payment of another dividend of the same amount on December 22. During the year additional property has been acquired from the Industrial Company, and property has been leased from the State Bank. A report by C. M. Rolker is attached, bringing the technical information up to October of this year.

Consolidated Gold Fields of South Africa.—The report of this company for the year ended June 30 shows a profit of £993,381, as compared with £1,283,851 a year ago. The policy of writing down the assets to keep pace with the exhaustion of the producing mines is being continued, but whereas £500,000 was devoted to this purpose a year ago, the sum of £200,000 is sufficient for this purpose this year. Dividends at the rate of 6% have been paid on £1,250,000 preference shares and 35% on the £2,000,000 ordinary shares. During the year the debentures have been reduced by £25,000 and now stand at £250,000. The reserve fund remains the same as before, namely £2,000,000, of which one-half is used in the business of the company and one-half is invested in government securities. The chief income of the company is derived from dividend-paying mines on the Rand of which Simmer & Jack, Simmer Deep, Robinson Deep, Village Deep, Jupiter, and Knights Deep, are the most important. The company also has a large interest in City Deep which will be producing within the next few months. The list of other investments published in the report is as usual of great interest. The Shamva and other Rhodesian companies, and the Fanti, Wassaw, and other West Africans account for large sums of money. The company has substantial holdings in the Victoria Falls & Transvaal Power Co., the Lena Goldfields, Oroville Dredging, Natomas Consolidated, and many other companies operating in various parts of the world. One investment representing about £50,000 is in the Northern Light Power & Coal Co., a company operating in the Yukon district, of which little is heard, though its headquarters are in London. The report states that the mining operations on the Rand under the control of the company have been greatly hampered by the scarcity of native labour, and in Rhodesia and West Africa the same trouble is prominent. The report by the engineers gives details of the work at various mines, and we shall deal with them subsequently under their several headings.

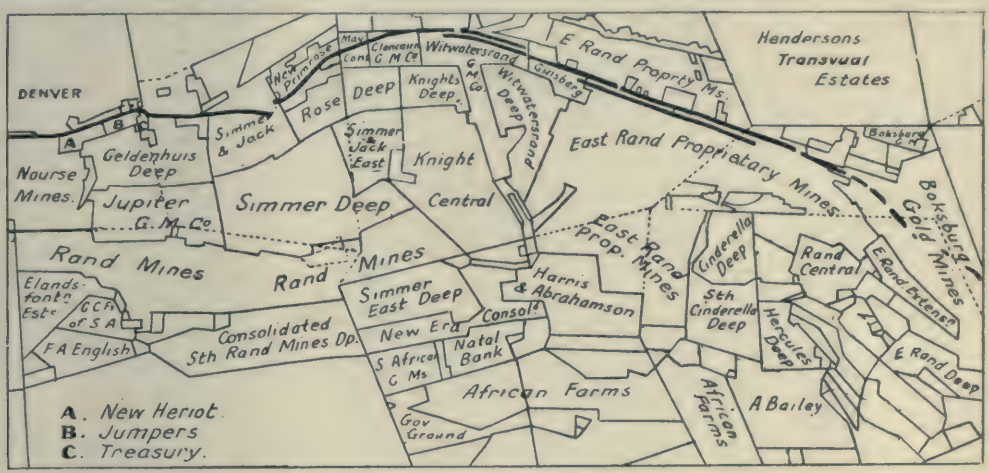
Nourse Mines. — This company belongs to the Wernher-Beit-Eckstein group and was formed in 1894 as the Nourse Deep to acquire the deep levels of the Henry Nourse mine in the central part of the Rand. In 1905 the property of the Henry Nourse company was absorbed and the name changed to Nourse Mines. G. E. Webber is consulting engineer and Percy Cazalet is manager. During the latter's absence on leave his place has been occupied by R. A. Barry. The report now issued covers the year ended July 31 and the results disclosed are not quite up to expectations. The value of the ore declined by 9d. per ton and the cost has been 1s. 7d. higher, due partly to the difficulty of securing efficient labour and partly to the fact that 100 of the stamps have been undergoing a thorough overhaul. An additional 80 stamps started work towards the end of the year making the total equipment 260. Further sums from revenue have been spent on capital account on the substitution of electric for steam power. During the year under review 521,785 tons was raised from the mine and after sorting 463,277 tons went to the batteries averaging 7⅜ dwt. The yield by amalgamation was 118,454 oz. and by cyanide 47,917 oz. a total of 166,371 oz. equal to 7⅛ dwt. per ton. The value of the gold was £697,809 or 30s. per ton, and the expenses including development £506,305 or 21s. 9d. per ton. Dividends absorbed £151,875. The development during the year has disclosed bodies of ore as follows: 4653 ft. on the Main Reef 30 in. wide and assaying 9 dwt., 3589 ft. on the Main Reef Leader 10 in. wide and assaying 28 dwt., and 3351 ft. on the South Reef 14 in. wide and assaying 23½ dwt. Based on stoping widths the tonnage added to reserve was 698,503 tons averaging 7½ dwt., and the total reserve on July 31 was 2,142,047 tons.

Jumpers.—This is one of the original outcrop mines in the central Rand, and as its name implies is a small portion of what would have been Geldenhuis ground if the surveyors of the latter company had worked accurately. The mine is nearing exhaustion. It now belongs to the Wernher-Beit-Eckstein group, and S. Richards is the manager. The report for the year ended July 31 shows that 150,329 tons of ore was raised, and after the removal of 35% waste, 98,196 tons went to the mill. The total production of gold by amalgamation and cyaniding was 43,953 oz. or 8·95 dwt. per ton of ore milled. At this mine sorting both below and above ground is done closely and the policy of large output and low cost is not adopted. In addition to the mine ore, 24,014 tons was taken to the mill from the dump, and 40,382 tons of accumulated slime was treated by cyanide. The total expenses were £155,276 and the profit was £62,435. The dividends absorbed £40,000. With regard to the future of the property, Mr. Richards estimated the reserve on July 31 at 63,523 tons, but he anticipates that as much again will be ultimately available from new ground and from old stopes; 6000 tons of old dump is profitable, as also is 42,000 tons of accumulated slime. As already reported negotiations are in hand for the joint working of the Jumpers and the Treasury mines, whereby the former will conduct the remaining operations and take two-thirds of the profit. By this arrangement it will be possible to mine the pillars left standing at the com-

mon boundary. The Jumpers has a most important asset in the 100,000 shares in the Benoni, one of the new mines in the far east Rand. The Benoni mill is now under construction and will be at work before the Jumpers mill passes out of commission.

Knights Deep.—This mine belongs to the Consolidated Gold Fields group and is on the dip of the Glencairn and Witwatersrand Gold Mining Co. which are Barnato properties. Milling commenced in July 1903. The company owns 200 stamps and rents 70 stamps from the Simmer & Jack East. During the year ended July 31 the amount of ore mined was 715,219 tons, and after the rejection of 9% waste 650,820 tons went to the mill where 162,933 oz. of gold was recovered by amalgamation and cyanide. The value of this gold was £683,420 or 21s. per ton of ore milled. The expenses were £399,030 or 12s. 3d. per ton, leaving a profit of £300,886 or 9s. 3d. per ton. On July 31 the ore reserve was estimated at 1,700,000 tons averaging 5½ dwt., but there are also important areas ready for mining where there are further supplies of ore not yet appraised.

Consolidated Main Reef.—This mine belongs to the Neumann group and is situated at Maraisburg, in the mid-western part of the Rand. The company was



EASTERN PART OF WITWATERSRAND.

formed in 1896 and crushing started with 20 stamps in January 1898. The present plant consists of 120 stamps and 3 tube-mills the latter having started in March of this year. S. C. Thomson is consulting engineer and C. H. Spencer general manager. The report for the year ended June 30 shows that 306,312 tons of ore was mined and after the removal of 23% waste 235,391 tons went to the mill. The total yield of gold by amalgamation and cyanide was 74,092 oz. or 6·3 dwt. per ton, and the ratio of extraction was 90½%. The receipts from the sale of gold were £310,389 or 26s. 4d. per ton and the cost was £237,813 or 20s. 2d. per ton leaving a profit of £72,575 or 6s. 2d. per ton. A dividend absorbing £69,327 has been paid, being at the rate of 7½%, bringing the total distribution to date 25%. During the year under review 24,134 ft. of development work was done and the reserve has been increased by 61,000 tons; on June 30 the reserve amounted to 414,150 tons averaging 6·3 dwt. The manager reports that the developments in the eastern part of the mine have been disappointing as the lodes contain much unprofitable ore, though the ground is not much disturbed by faults, a feature usually characteristic of this part of the Rand. The general conclusions of the manager based on knowledge of the district are that at greater depth a better quality of ore will be found. Towards the western end the ore has improved and before long the monthly yield will probably increase. In order to facilitate development of this part of the mine the Central shaft has been unwatered. The equipment of the new vertical shaft is nearly complete.

Main Reef West.—This mine is situated to the west of the Consolidated Main Reef and is under the same control and management. Operations were started in February 1909 with 80 stamps and during the last year an additional 40 were erected. Two tube-mills have been erected and another is on order, but none have been put into commission as the amount of ore mined has not yet overtaken the capacity of the 120 stamps, which can comminute the whole of the present output to 30-mesh. The development and further equipment of the mine is progressing rapidly and some quick shaft-sinking has been done. It is expected that it will be possible to greatly increase the output in about a year's time. The report for the year ended June 30 shows that with an average of 103 stamps, 189,649 tons was milled yielding by amalgamation 46,387 oz. and by cyanide 27,104 oz., a total of 73,491 oz. valued at £307,787. The yield was 7¾ dwt. or 32s. 5d. per ton, and the proportion of extraction was 92%. The working cost was £169,837, leaving a profit of £137,950, the figures per ton being 17s. 11d. and 14s. 6d. respectively. The company has been able to declare its first dividends, Nos. 1 and 2, amounting in all to £112,500 which is at the rate of 25%. During the year additional capital expenditure has been incurred chiefly in connection with shaft-sinking and equipment, to the amount of £86,686, of which £5648 has been provided out of revenue and the remainder out of the proceeds of an issue of £300,000 debentures, specially made two years ago for this purpose. The reports by the engineers show that progress is continuous and that the ore reserve is 74,000 tons higher than a year ago, standing now at 430,000 tons averaging 7·9 dwt.

Great Fitzroy.—An abstract of the first report of this Queensland copper mine was given in our issue of October last year. Since then we have published the announcements of the managers, Bewick, Moreing & Co., to the effect that the ore reserve had been over-

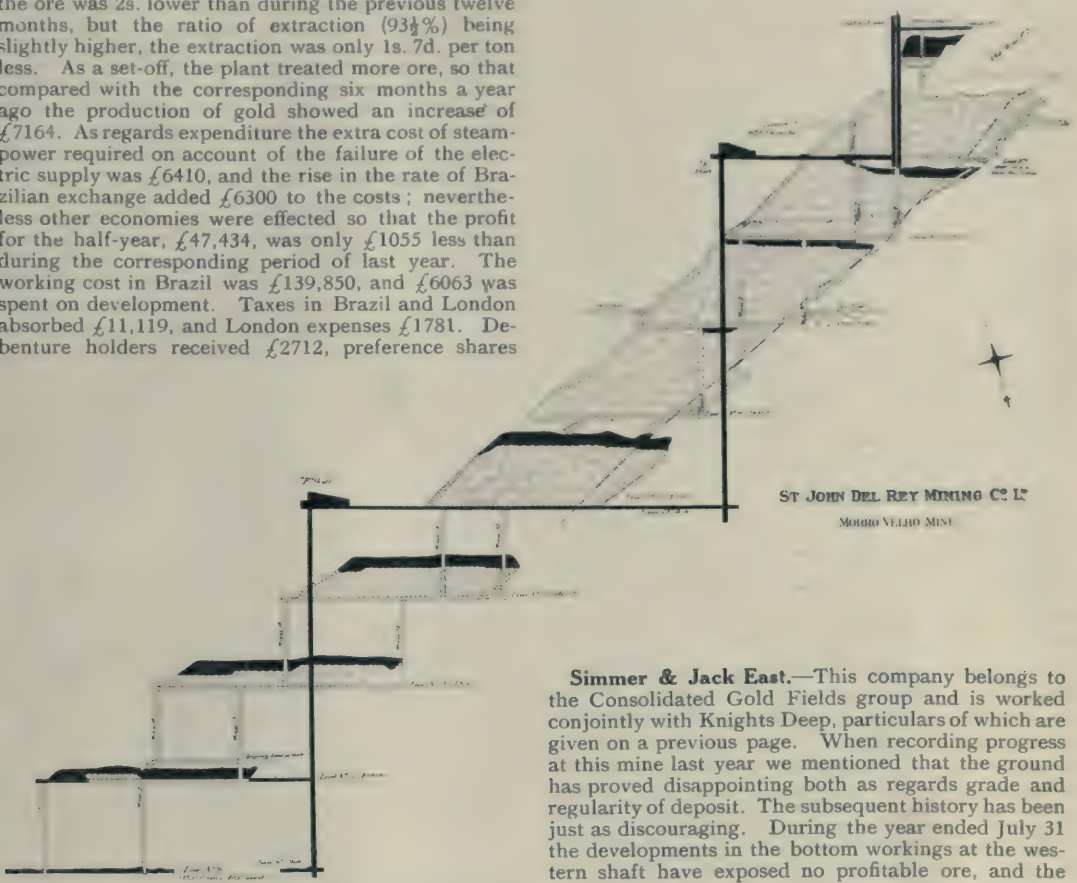
estimated by their superintendent and that the table-concentration was not a success. W. J. Loring had visited the property and reorganized the operations, discarding tables for the flotation plant of the Minerals Separation Co. The second annual report has now been issued, covering the operations of the year ended June 30 and containing an extensive review by W. J. Loring dated July 16. The issued capital of the company was £450,000 of which shares representing £337,060 were issued in exchange for shares in the vendor company and £112,940 was subscribed in cash. The working account for the year under review showed expenses £90,171, and income from the sale of matte £79,311, leaving a loss of £10,860. In addition £79,851 has been spent out of capital on plant and buildings and £22,274 on developments. In order to provide further funds, £75,000 debentures have been allotted and 100,000 new shares have been created. During the year 53,416 tons of ore was mined, 44,170 tons containing 3·1% copper and 3 dwt. gold was smelted, and 9246 tons sent to the concentrator. The latter ore averaged 2·7% copper and 2·67 dwt. gold, and yielded 1777 tons of concentrate assaying 6·84% copper and 6·18 dwt. gold. This works out at less than 50% extraction. The matte produced contained 1268 tons copper, 6482 oz. gold, and 35,204 oz. silver. Treatment was suspended during January, February, and March, as the necessary coke could not be obtained owing to the coal strike. Mr. Loring estimates the reserve of silicious ore at 562,913 tons averaging 3·08% copper and 2·62 dwt. gold, and of pyritic ore at 91,920 tons averaging 2·38% copper and 2·25 dwt. gold. The future policy is to smelt 6000 tons of raw ore per month and send 6000 tons to the flotation plant, and the estimated cost is 31s. per ton for the ore smelted direct and 23s. 3d. per ton of ore that is concentrated. The additional plant for floating, sintering, and converting will cost £18,000.

Mount Elliott.—This English company was formed in 1907 to acquire the Mount Elliott copper mine 72 miles south of Cloncurry, North Queensland. E. A. Weinberg is consulting engineer and W. H. Corbould is manager. In recording the progress of this company a year ago we mentioned that Mr. Corbould did not approve of the cramped position of the smelting works and had decided to transfer the plant to a more convenient spot. The report for the year ended June 30 last shows that the old smelter ceased work at the end of July last year and the new plant was put into commission on September 1 of this year. Consequently the production during the year covered by the report was only 457 tons of blister copper containing 731 oz. gold and 548 oz. silver. Since the new plant came into operation the monthly reports for September and October show 9095 tons of ore smelted and 1085 tons of blister copper produced containing 1803 oz. gold and 1249 oz. silver. The sale of copper and gold produced during July yielded £24,085 which was sufficient to pay for all mining and treatment costs and to leave a balance of profit of £6790 for the year ended June 30, 1910. The amount of development work done during the year was not great; it was considered better to concentrate operations on the reconstruction of the smelting plant, seeing that the ore reserve was substantial amounting to 140,000 tons of ore averaging 10 to 12% copper and 300,000 tons averaging 3%, all above the 4th level. Mr. Corbould prefers not to give estimates of any ore below this level, as the ore is of a different character from the lens of high-grade ore which has been worked so far. He considers the rich ore to be secondary and the primary ore of which there is evidence of large quantities has to be developed and estimated from a different standpoint. The report contains a detailed description of the remodelled smelter. The blast-furnace measures 168 by 42 in., and there are three converter stands.

Tyee Copper.—This company was originally formed in 1900 to acquire copper mines on Mount Sicker, Vancouver Island, but as we mentioned when reviewing the report a year ago the mine is exhausted and the company now operates its two furnaces as a custom plant. The report for the year ended April 30 shows that progress in this business has been as satisfactory as the state of the copper market will permit. During the year under review 45,760 tons of custom ore was smelted and the furnaces were running half time. This compares with 29,550 tons the year before. Since the close of the year the purchases have been 17,255 tons, a rate which shows a further increase. The difficulties in the way of securing ore are great. For one thing the depression in the copper market has discouraged the development of deposits everywhere, especially in the northwestern parts of the Dominion where the Tyee company expected to find many customers. The company also suffers from the keen competition and opposition of older smelters in the northwest of the United States. The manager, W. H. Trewartha James, is in active search for supplies and also for properties, and as the company is backed by the Siemens group, additional funds will be forthcoming whenever it is considered desirable. The report under review shows that the financial position of the company is improving; the loss for the year was only £1200 as compared with £22,000 a year ago. The plant is kept in excellent order. The board and manager are optimistic, and look forward to the future with confidence.

Ouro Preto Gold Mines of Brazil.—This company was formed in 1884 to acquire the Passagem and adjoining mines in Minas Geraes, Brazil. The management is in the hands of John Taylor & Sons and A. J. Bensusan is the superintendent. We may remind our readers that in our last issue we gave a précis of a paper by Mr. Bensusan on the mining and metallurgy at Passagem, and we may add here that the company is hampered by an unsympathetic tax-collecting government, and by the undependability of the rate of exchange between Brazilian money and standard gold. The capital of the company is 100,000 ordinary shares, and 36,634 preference shares entitled to a 10% cumulative dividend. The preference dividend has been paid up to date, but the ordinary shares have only received 17½% since 1893. The report for the year ended June 30 shows that 75,612 tons of ore yielded gold valued at £108,773 equal to a recovery of 7 dwt. per ton. The total expenses including £3712 paid as tax on the export of gold were £94,435, leaving a balance of profit for the year of £15,814. Out of this £8135 has been allowed for depreciation, £3663 has been paid as preference dividend, and a dividend of 2½% has been paid on the ordinary shares absorbing £2500. Owing to influx of water the amount of development has been curtailed, and the reserve on June 30 was 169,991 tons as compared with 202,030 tons a year ago. During the year electrical pumping plant has been erected and the water in the mine is now fully under control. The report mentions that the subsidiary company formed to acquire alluvial tracts has been wound up, as the ground has been proved of no practical value. It is also announced that the Maquine and Santa Anna properties situated 3 miles away from Passagem have been let under option on favourable terms. These mines were acquired by the company ten years ago, and they were at one time substantial producers.

St. John Del Rey.—In previous issues we have given a historical account of this famous gold mine in Brazil and we need not recapitulate it now. The half-yearly interim report now published covers the six months ended August 31 During this period 94,504 long tons of ore was mined and 92,400 tons sent to the 120-stamp mill. The total extraction by amalgamation and cyanide was worth £204,659 or 44s. 2d. per ton, of which 30s. 2d. per ton was obtained by amalgamation and 14s. per ton by cyanide. The average assay value of the ore was 2s. lower than during the previous twelve months, but the ratio of extraction (93½%) being slightly higher, the extraction was only 1s. 7d. per ton less. As a set-off, the plant treated more ore, so that compared with the corresponding six months a year ago the production of gold showed an increase of £7164. As regards expenditure the extra cost of steam-power required on account of the failure of the electric supply was £6410, and the rise in the rate of Brazilian exchange added £6300 to the costs; nevertheless other economies were effected so that the profit for the half-year, £47,434, was only £1055 less than during the corresponding period of last year. The working cost in Brazil was £139,850, and £6063 was spent on development. Taxes in Brazil and London absorbed £11,119, and London expenses £1781. Debenture holders received £2712, preference shares



£5292, and ordinary shares £19,271, being 8d. per share. The balance £18,571 was transferred to capital account for new works. During the half-year an additional 10 stamps were erected and the 120 stamps will be gradually overhauled without the output being curtailed. The Peixe hydro-electric station is well advanced and 1000 hp. will be available from this source before long. To give some idea of the engineering difficulties at this mine we print herewith a section of the lower levels showing the progress of work at February 28 last. The orebody dips flatly and the lowest level is 4300 ft. vertical below the adit, thus making the mine the deepest in the world. The upper parts have caved and operations are now conducted through vertical shafts which cut the orebody at the No. 8 level. Below this, hauling is done through a succession of vertical shafts and levels, necessarily adding to the cost but unavoidable owing to the nature of the work to be done. George Chalmers, the manager, reports that during the half-year the lode uncovered on No. 16 horizon compares favourably with the bodies found above, the length being 864 ft. and the average width 12 ft. Winze No. 21 is being sunk from this horizon and is now down 300 ft. Horizon No. 17 will be forthwith commenced at this depth, and winze No. 22 will also be started before long. The level from shaft F to the site of the proposed shaft G was 800 ft. long in September, when it was connected with horizon 16 thereby improving the ventilation.

Simmer & Jack East.—This company belongs to the Consolidated Gold Fields group and is worked conjointly with Knights Deep, particulars of which are given on a previous page. When recording progress at this mine last year we mentioned that the ground has proved disappointing both as regards grade and regularity of deposit. The subsequent history has been just as discouraging. During the year ended July 31 the developments in the bottom workings at the western shaft have exposed no profitable ore, and the workings at the eastern end have not been much more productive. In addition scarcity of labour has interfered with operations. The ore reserve on July 31 was estimated at 950,000 tons averaging 5·4 dwt. as compared with 728,000 tons averaging 5·8 dwt. a year ago. The reason for this increase is solely the inclusion of additional bodies of low-grade ore, not previously considered profitable. During the year under review 432,828 tons was mined and after the removal of 15% waste, 365,620 tons was sent to the mill. This was less than the capacity, as was also the case during the previous 12 months, so that the company continued to lend 70 out of the 200 stamps to the more prosperous Knights Deep. The total recovery was 93,214 oz. valued at £390,890, or 21s. 4d. per ton milled. The working cost was £326,901 or 17s. 10d. per ton, leaving a profit of £63,989 or 3s. 6d. per ton. Out of this, £45,820 has been paid as interest on £833,400 debentures. The 650,000 ordinary shares receive nothing, a condition of things that has ruled since the formation of the company in 1895.

Witbank.—This company owns a colliery in the Transvaal, situated 70 miles due east of Pretoria, and about 80 miles from the centre of Johannesburg. Railway connection with the latter is made by a branch from the Pretoria-Middelburg line, entering the Rand at the far eastern end. The coutrol is in the hands of the Neumann group, and H. L. Tamplin Lewis is the manager. Operations commenced in 1898 and the output has gradually increased. During the year ended August 10, the amount raised was 814,150 tons, as compared with 740,497 tons the year before and 561,867 tons during the year ended August 31, 1908. The profit for the year was £90,585, out of which £63,000 has been paid as dividend, being at the rate of 30%, comparing with 25% the year before.

Chinese Engineering and Mining.—This company was formed in 1900 to acquire from Chinese owners the Kaiping collieries situated in the province of Chih-li, near the Gulf of Pe-chih-li. The report for the year ended February 28 states that the output of coal is increasing and that the gross profits were £243,298. Out of this £23,873 was paid as interest on debentures, £10,000 devoted to redemption of debentures, £30,000 placed to reserve for depreciation, and dividends at the rate of 15% paid absorbing £150,000. The company is still troubled by disputes with the Chinese Government as to certain rights claimed by the government. Various propositions are put forward from time to time, but a settlement seems as far off as ever.

Cape Copper.—This company belongs to John Taylor & Sons' group and was formed in 1863 to work the Ookiep mine in Namaqualand, Cape Colony. The high-grade ore is shipped for treatment at Britonferry, South Wales, as also is the matte produced by smelting the low-grade ore on the spot. For some time it has been known that the Ookiep mine is approaching exhaustion, but as the years go by, there is always some more to be extracted. During the year ended April 30 last, 15,196 tons was extracted averaging 14·5% copper, as compared with 15,968 tons during the previous year averaging 15·5%, and the reserve is estimated at 8000 tons containing 20% metal, as compared with 10,000 tons a year ago. The company has also extracted 54,050 tons averaging 5·4% copper from the Nababiep mine and the reserve has been increased from 150,000 to 219,800 tons averaging 5%. Smaller amounts have been extracted from the Narrap and Carolusberg mines which are being experimentally developed. The report also mentions that work is being done on properties in Alaska and India. The company has a half-share in the profits of the Tilt Cove Copper Co., owning a mine in Newfoundland, the ores from which are treated at Britonferry. The profits for the year under review were £124,659, of which £7050 was derived from the profits of the Tilt Cove company. This figure compares with £90,223 a year ago, the increase being due to the greater amount smelted at Britonferry. During the previous year a strike rendered these works idle for three months and the stocks of ore and matte accumulated; some of the arrears have been worked off thus making the output and profit greater. The dividends distributed were £9000 on the preference shares and £60,000 on the ordinary shares, being at the rate of 10% in both cases. The total dividends to date have been £4,456,150.

Mexico Mines of El Oro.—Inour October issue we published a report of the annual meeting of the shareholders of this company. On that occasion the chairman gave a full account of the prospects at the mine, and warned his hearers to expect a decrease in the average value of the ore. The Board at the time promised that the manager, A. F. Main, on his return to Mexico, should send a further report as to conditions and prospects. This report has now been received and has been circulated. It shows that the recent developments have not increased the ore reserves at the rate required by the increased capacity of the mill. During the four months, July to October, the addition to the reserve has been sufficient for two months supply at the present rate of working. It also mentions that the timbering in the south shaft is rapidly deteriorating and that retimbering is urgently necessary. Mr. Main had previously hoped that the timbering would last long enough to enable him to complete arrangements for temporarily handling the whole output through the north shaft. The deterioration has recently progressed at a greater rate, and it will be necessary to proceed at once with the replacement of the timbers. While this is being done the output of the mine will have to be reduced, as the capacity of the north shaft is not yet equal to the full amount of the output. Mr. Main's report on the mine is gloomy reading, and he does not disguise the fact that the method of working the mine under the altered circumstances will have to be considered in such a way as if it were an entirely new proposition.

Montana-Tonopah.—This company, operating a gold-silver mine at Tonopah, Nevada, has issued its eighth annual report. Charles E. Knox is general manager, and Edgar A. Collins is superintendent. The average value of the ore is about $15, and much of the material milled is barren owing to the ore being found in rich narrow veins. During the year ended August 31, 50,245 tons was treated by an average of 38½ stamps, and the production was 1076 tons of concentrate worth $245,304, and 39,981 lb. of bullion worth $405,100. The value of the metal extracted was $15·22 per ton, or 4 dwt. gold and 21 oz. silver. The rates of extraction was 90·8%. The total receipts were $650,405, and the expenses were $515,689, or $10·25 per ton, leaving a profit of $134,715. No dividend is being distributed. The report shows that no discovery of importance has been made during the year, but the successful development of bonanza ore at the adjoining Belmont property has encouraged the hope that higher grade ore may be discovered. Of the 10,681 ft. of development work done during the year, 4234 ft. was in ore. No estimate is made regarding reserve owing to the nature of the deposit, but enough is known of the ore to make it certain that there is sufficient to fully occupy the mill for many months. J. E. Spurr has recently made a survey of the Tonopah ore deposits, and his report on the Montana-Tonopah property is expected before the end of the year.

Cinnamon Bippo.—This is one of the mines on the Tarkwa banket range controlled by the Consolidated Gold Fields of South Africa. Work is now concentrated on development, and to provide the necessary funds, 123,760 new shares of £1 each were created during the past year, and 56,437 were issued for cash, bringing the total number of shares issued to 186,650. The first part of the development work was organized by Walter Broadbridge, and since May of this year Henry Hay has been in charge. The present report covers the financial year ended June 30, and incorporated with it is a report by Mr. Hay dated July 19. He describes the work done during the year and shows that 7156 ft. of development work was done. The new main shaft was down 324 ft.; it measures 19 by 6 ft. within timbers and has four compartments. The reserve of ore was estimated at 241,669 tons, averaging 7·81 dwt. There were also three blocks of ore on the main adit level south aggregating 18,642 tons and averaging only 3·96 dwt.

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